FARM EQUIPMENT

FOR

MECHANICAL POWER

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BY

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TO THE

AGRICULTURAL ENGINEERS

WHO HAVE CONTRIBUTED TO AN
ART MORE FUNDAMENTAL AND IMPORTANT
THAN ANY OTHER,

THIS BOOK IS RESPECTFULLY

DEDICATED

PREFACE

MECHANICAL power is today successfully replacing animal power in Agriculture As a result, the farmer can complete his usual work in less time than heretofore, and can give more attention to effective and profitable marketing of his produce. Farms properly organized for successful use of mechanical power, such as a tractor, are a means to this end.

The author offers this book on farm machinery and its operation as an aid to the manufacturer of farm equipment, to the dealer, distributor, and service man, and primarily to the farmer himself It is also intended for college courses and for the use of students in their later professional work. Actual field experience and observation have provided the material for this volume. The data are not limited to one locality; they are general, and are based on averages which may readily be modified to meet the specific conditions of any region or special crop

It is essential that all those who work with farm machinery should understand not only the tractor which supplies the mechanical power, but also the plows, harrows, harvesters, threshers, shellers, grinders, and other drawn or belt-driven machines which perform the actual work of the farm. The correlation of the tractor with the appropriate farm unit, and the function, sizes, field of operation, power requirements, and capacities of each of these units are fully considered in this book.

Many of the chapters of the manuscript were read by prominent agricultural engineers, specialists in the various topics treated. Such literature as is available was studied—but on several of the subjects little or nothing has been published heretofore.

The author wishes to express his gratitude to the manu-

facturers of farm operating equipment and their accessories. Not alone have they been liberal in supplying illustrations, but their engineers, service men, and salesmen have given liberally of their time to discuss many of their problems with the author. To the following and others the author is indebted: Advance-Rumely Company; S. L. Allen & Company; American Seeding Machine Company; American Well Works; Appleton Manufacturing Company; Aultman-Taylor Machinery Company; Avery Company; Bateman Industries; Belcher & Taylor; Belle City Manufacturing Company, Burch Plow Company; J. I. Case Plow Works Company, J. I. Case Threshing Machine Company; Challenge Company; John Chatillion Company; Curtis Publishing Company; Deere & Company; Jos. Dick Manufacturing Company; Federal Department of Agriculture; Gehl Manufacturing Company; Holt Manufacturing Company; Huber Manufacturing Company; Hyatt Roller Bearing Company; International Harvester Company, Joliet Manufacturing Company; Letz Manufacturing Company; Litchfield Manufacturing Company; Minneapolis Steel & Machinery Company; Moline Plow Company; Nichols & Shepard Company, Ohio Cultivator Company; Oliver Chilled Plow Works; Papec Manufacturing Company; Rock Island Plow Company; Roderick Leon Manufacturing Company; Rosenthal Corn Husker Company; Russell & Company; I. B. Rowell Company; Silver Manufacturing Company; Smalley Manufacturing Company; Thomas Manufacturing Company; Timken Roller Bearing Company; Tractor Appliance Company; United States Rubber Company.

F. N. G. K.

November, 1923.

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FOR

MECHANICAL POWER

PART I

DRAW-BAR MACHINES

CHAPTER I

THE PLOW

Function.—A plow should form a mellow layer of earth by changing the texture of the ground from its hard original state. By its action it should transfer vegetation from the surface of the ground to the mellow part below where, together with fertilizers, it may decompose and liberate plant food. Unless a plow loosens and disintegrates the soil particles, it has failed to plow well.

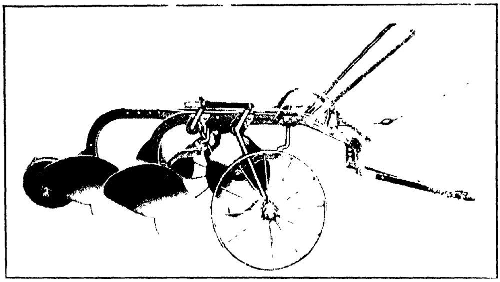


FIG. 1.—Mold-board tractor plow.

Types.—There are two distinct types of plows: the *mold-board* and the *disc*. The latter is a much more recent development. Both have the same function to perform; they are tillage tools.

THE MOLD BOARD PLOW

Types, Sizes, and Rating.—Mold-board plows may be subdivided into two classes, *steel* plows and *chilled* plows. These classifications refer to the bases or bottoms. Mold-board plows

are rated in sizes according to the width in inches of the furrow which they will plow: 12-inch, 14-inch, or 16-inch. For tractor use the 14-inch plow is almost universally employed.

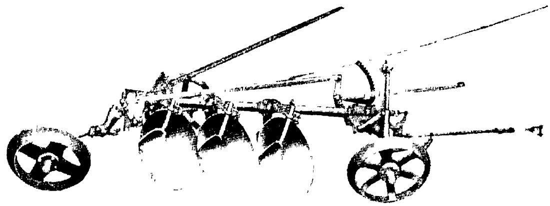


FIG. 2.—Disc tractor plow.

For very heavy plowing, where the power is limited, 12-inch plows are sometimes used, and frequently, one 16-inch plow will serve in place of two 12-inch bottoms for use with small tractors.

Bottoms for mold-board plows may be divided into three common classes: (1) the breaker or sod plow, (2) the general purpose or turf and stubble plow, and (3) the stubble plow. Many modifications of these are to be found, but the general classes are nearly always maintained.

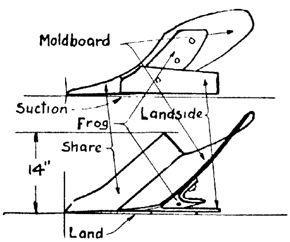


FIG. 3.—Plow bottom, showing "Suction" and "Land."

The soil characteristics of a given locality determine which of these different kinds is needed. Plows do not vary greatly except in respect to material hardness. Steel plows are more common than chilled plows.

Steel Plows are made of soft center plow steel, which consists of a layer of low carbon steel welded between two layers of crucible steel The latter may be tempered to take on a hard surface. The soft center gives this part of the

plow rigidity without brittleness. The outer, or hard, sheets give the plow part the hardness which makes for good scouring and long wear. Furthermore, the soft center gives the metal the strength necessary to avoid the danger of breaking.

Chilled plows are made of cast iron poured against a piece of iron which causes it to "chill" and become very hard. This

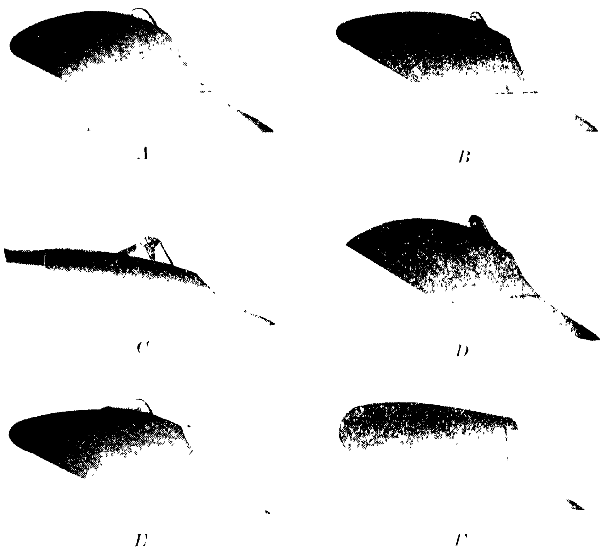


FIG. 4.—Showing plow bottoms. *A*, Stubble bottom; *B*, General-purpose bottom; *C*, Breaker bottom; *D*, Wax-land bottom; *E*, Stony-land bottom; *F*, Chilled-plow bottom.

type of plow is used because of its extreme hardness. It lends itself very well to certain soils. In gravelly or sandy loam soils which have a decided tendency to wear away even the hard-tempered, soft-center steel, this extremely hard, chilled iron material is best for plowshares and mold-boards. In some localities it may be found that a soft-center mold-board

will go well with a cast-chilled share. However, where this share is used, it will be found that for the mold-board as well this material is the most appropriate. The shapes of chilled plow bottoms are distinctive. The illustration shows the most common chilled plow bottoms.

Plow Bottoms.—The principal part of a tractor plow—and, in fact, of any plow—is the bottom or base. This bottom is composed of several essential parts, *frog*, *share*, *landside*, and the *mold-board*. The *frog* forms the frame onto which the other parts are built and held in place relative to one another. The *share*, which in some localities is called the "lay," forms the entering part or, in other words, the "business end" of the plow. It cuts the furrow slice at the bottom and side. The *mold-board* lifts, turns, and pulverizes the soil over which it passes after leaving the share. The *landside* forms the guiding part of the plow and carries side reactions, due to lifting the furrow slice on an angle and turning it.

FIG. 5.—Slat-bottom for sticky soil

The bottoms must have proper "suction" and proper "land" to work well. *Suction* is the clearance at the lower side of the point of the share which holds the plow in the ground. *Land* is that clearance on the landside which makes for easy running and reduced friction. This "land" clearance and the "suction" clearance must be provided on all plows to secure light draft and good work. The suction usually varies from $\frac{1}{4}$ to $\frac{3}{8}$ inch on different makes of plows. The land varies from $\frac{1}{8}$ to $\frac{1}{2}$ inch. The share clearance rarely exceeds $\frac{1}{4}$ inch. In fact, all these elements should be in proportion on the same bottoms. The wing of the share should be on a plane with the point. On tractor plows, in fact, on any wheeled plow, only the very edge touches. On walking plows, there is a flat surface called "bearing" which should always be provided.

Tractor mold-board plows, as a whole, may be sub-classed as "rigid frame" and "independent" or "flexible beam" plows. The *rigid frame* plows are most commonly made in 2, 3, and 4 bottom gangs. Some may have another bottom added and be termed "2-3," or "3-4," or "4-5" bottom plows.

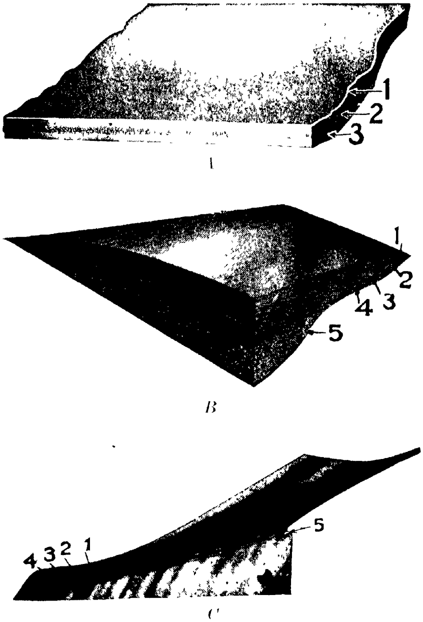


FIG. 6.—Showing plowshares. A, Soft-center steel; B, Crucible steel patch on point; C, Landside of share showing reinforced point.

These plows may also be power or lever lift. The former are by far the more popular and practical for tractor use.

Hitching and Field Operation.—About seventy-five per cent of the trouble experienced at the beginning by operators of tractor plowing outfits is due to improper hitching of the

plow to the tractor. Many times, due primarily to an improper understanding of the hitching, a whole season's plowing is poorly done. To plow well with the rigid-frame, power-lift, mold-board tractor plow, the plow should run level and the bottoms should be parallel to the preceding furrow wall. It should run straight. It should cut the correct width. It should cut at a uniform depth and width. It should go into and out of the ground quickly. It should lift high enough to clear trash It should be set so that the work of lifting the furrow on the mold-board is carried equally on all of its wheels. Failure in these matters means faulty adjustment somewhere. And it means poor plowing. It may also bring about wear on the various plow parts that will call for delays and early replacements. Taking hold of the wheels an instant as if to stop them by slipping them as the plow is at work, will easily reveal whether all three have nearly equal loads. Proper load distribution on all the wheels is important, because it gives the wheel with the lifting device the proper traction to enable it to lift quickly and efficiently.

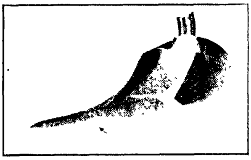


FIG. 7.—Suction on bottom.

Care should be exercised to see that the bottom of the landside at the heel has the proper clearance due to suction. The land clearance should also be noted carefully each day. It reveals whether the plow hitch and adjustment are correct. It shows instantly whether the plow is running true. A rubbing landside means excess draft, rapid wear, and early replacement.

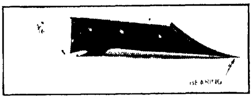


FIG. 8.—Share showing clearance between bearing and point.

It is only necessary to make sure that the correct width is being cut by the forward bottom. The other bottoms are always set correctly in manufacture. The cutting width of

Running the tractors with one of the drive wheels in the furrow or both on the unplowed ground will determine the location of the center line of pull with reference to the furrow wall. With drive wheels on the unplowed ground, allowance must be made for a certain distance of the drive wheel

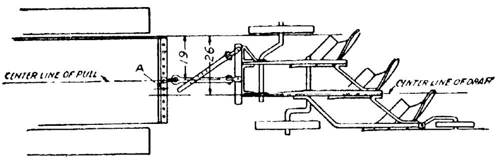


FIG. 10.—Three-bottom plow hitched to tractor with one drive-wheel in furrow.

from the edge of the preceding furrow wall. Where the center line of pull of the tractor and the center line of draft of the plow do not coincide, it is best to divide the difference on the tractor draw-bar and on the plow and hitch midway between these points. It either is to be favored, let it be the plow,

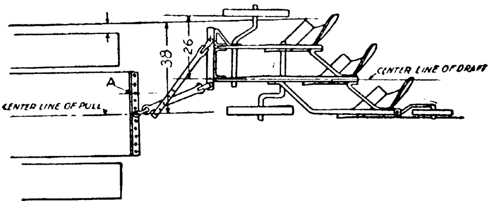


FIG. 11.—Three-bottom plow hitched to tractor with both drive-wheels on land.

which means hitching closer to the center line of draft on the plow, whereas it means hitching farther away from the center line of pull on the tractor. It is this distance, the difference between the center line of pull and the center line draft, that is commonly called "side draft."

Hitching on the center line of "pull" of the tractor and back to the plow on this line, throws all this side draft on the plow. Hitching on the "center line of draft" of the plow throws all this side draft on the tractor. The most desirable conditions, where no side draft exists, can be found where the center line of draft and center line of pull exactly coincide.

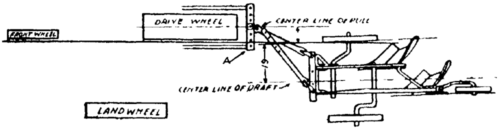


FIG. 12.—Tractor with only one drive-wheel, which, if in the furrow, makes too much side draft.

The illustration Fig. 11 shows a three-bottom plow improperly hitched to a tractor It may be seen that the plow is not running true at all. It is, in fact, so badly set that it skids continually. Working a plow at this angle, as shown, means poor plowing, heavy draft, and rapid wear of landsides, which calls for early replacements.

A hitch which throws the plow away from the land is also illustrated. This means that here, too, poor plowing is the result. It also means rapid wear on plow parts.

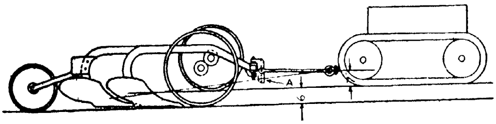


FIG 13—Low hitch on tractor

Not alone in these two cases is damage done to the plows, but the job of plowing is so poor that it may be reflected in the crop grown on that land.

Both plow and tractor can easily carry some side draft. They can carry 4 or 5 inches for the average sized tractor

rating at a three-four plow machine. Larger tractors could carry more, although it is rarely required, since the greater the number of plows hitched behind a tractor, the nearer it throws the center line of draft to the center of pull on the tractor.

The poor effects of a tractor equipped with a very low hitch are illustrated. It will be noticed that in a hitch of this kind, when the tractor is used for plowing, as shown, there is a decided pull downward on the front end of the draw bar of the plow—that is, on the front furrow wheel and the land wheel. The rear wheel, therefore, has less load; in fact, there is a tendency for it to lift.. A plow with a low or downward slope of draw bar toward the tractor, will, as the plowman terms it, run "on its nose." The rear end will sway badly and not stay in its place. This is termed "tailing," and should be watched closely All operators should aim to avoid it for it means increased draft, rapid wear on the share, and poor plowing.

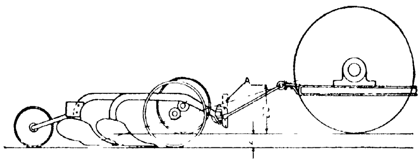


FIG. 11—High hitch on tractor.

A plow with a hitch too high is also shown. A high hitch is just as bad as a low hitch. In this case the tendency, due to the pull of the tractor, is to lift the front of the plow. Since one of the front wheels usually drives the lifting device, it can readily be seen that taking away part of the traction will effect the lifting.

A slow acting lift means poor plowing. The cause in the field of a lagging lift is nearly always found in too high a hitch on the tractor. It may also be too low a hitch on the

plow clevis, and in such a case shallow plowing is the result. Sometimes reversing the vertical clevis on the plow, turning it bottom side up, will enable the operator to get a better hitch between the plow and the tractor. The uneven weight distribution also brings an extra heavy load on the rear furrow wheel, with resulting rapid wear. This fault can easily be detected, because it forces the operator to pull the trip rope ten or twelve feet before reaching the end of the furrow in order to make sure that the plow is out of the ground at the proper place. The same thing may be true when plows are tripped into the soil In such cases a big area of land is plowed too shallow—often dangerously shallow, as reflected in the crop grown, particularly if it be corn.

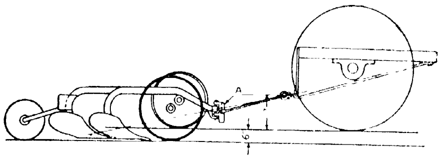


FIG. 15.—A good vertical hitch for mold-board plows.

The correct place on which to hitch the vertical clevis of the plow is dependent on load and soil conditions. If the load is carried equally on all plow wheels, there is ample assurance that the position is about correct. This is best determined, as explained above, by taking hold of the rim or tire of each wheel and slipping each one in turn as the plow is actually at work in the field. Keeping an eye on the tracks made by these wheels will, in a measure, reveal how well the load is distributed on all the wheels

Care of the Plow—Wheels, coulters, ratchets, cams, shafts, and chains should be lubricated thoroughly and all bolts kept tight to make sure that no parts loosen and are lost. The tension on springs should be such that they will do the work for which they are intended. A spring used to help lift the

plow out of the ground should not be set tight enough to retard the action of the plow when it enters the ground. As mentioned before, the rear or heel of the landside should run about one quarter of an inch from the bottom, and about that much from the side of the furrow. On nearly all plows the rear furrow wheel axle has means for setting this landside clearance. On some, there is a set screw that allows for very careful setting of this part of the plow, on others, a collar

FIG. 16.—An example of good plowing.

with set screws that permit setting this part. Where clutches lined with a friction surfaced material are used, it is well to see that this material is always in good shape. Where chains, gears, or cams are used, it is well to make sure that these parts are lubricated to do their work with the least amount of wear. Where plain bearing wheels are used, they should be kept well greased with a good grade of cup grease. The grease cups should be filled twice a day and screwed down every few hours. Care should be exercised on this score, in order to avoid a worn wheel box which wobbles so badly that either it

or the axle will need replacing. The scraper on the rear furrow wheel has an important function to perform. It removes all dirt which accumulates on the wheel. For this reason it should be set just as close to the wheel as possible without rubbing. If set too far away, a lot of dirt is accumulated that sticks to the wheel and increases its diameter—often enough to raise the plow too high in the rear, thus wearing the points of the share needlessly. Keep this scraper in its proper place.

If the plow is to be idle for more than twelve or fifteen hours, it will be well to grease the bottoms and coulter blades thoroughly to prevent rusting. Under no conditions leave a plow in the soil even during the hour for the noon meal. This precaution is necessary to good scouring and long life of the plow. Axle grease will serve the purpose if no other grease is available, but these parts must be well greased, even if the plow is in a shed and under cover Otherwise moisture will in a short time ruin a good steel plow bottom In the case of chilled plow bottoms greasing of the parts is not so important, although good policy.

Rolling Coulters.—The adjustment of a rolling coulter varies with soil, moisture, and soil differences. In fact, in some soils and soil conditions, coulters cannot be used at all. Generally, however, they give a decided value to the plow. They reduce draft and by cutting the furrow clean and sharp enable the plow to lift and pulverize the soil more thoroughly as it passes over the share and mold-board.

A jointer is often used in combination with the coulter, usually because there is a thick growth of weeds or perhaps green manure to be plowed under. For such work the jointer will be found very satisfactory. There may be cases, however, in which the jointer will interfere. In some soils where scouring is entirely a question of pressure of soil on the mold-board, the jointer may reduce the pressure so much that it prevents scouring. In this case the jointers should, of course, be removed. Or it may even be necessary to remove the coulter entirely. Raising the coulter and jointer as

a unit may remove the difficulty. The extreme point of the jointer should be set as close to the coulter blade as possible without actually touching or rubbing, and from this point back there should be a slight clearance. This makes for clean good work by the jointer. When difficulties are encountered which cause trash—such as stubble—to wedge between the jointer and coulter blade, the point of the jointer is not very clearly set as described above. If these parts are not set in the right way, materials may wedge in between them to stop

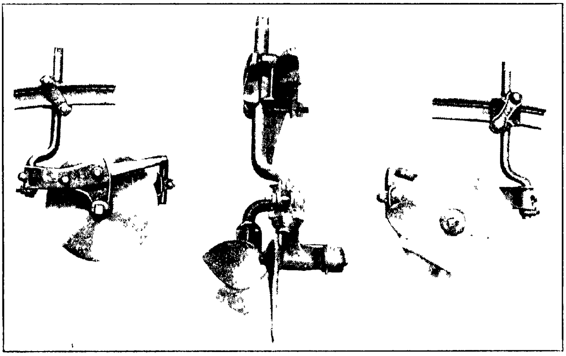


FIG. 17.—Coulter with jointer, showing each side and a front view.

the coulter from revolving and ruin the coulter blade by this constant wear in one place before the trouble is actually noticed.

The coulter setting for prairie breaking should be very close to the shin of the plow and about one-half inch to the land. This helps to cut the grass roots and make the plowing easier. Breaking sod is usually from 3 to 4 inches deep and the coulter will help the work of the plow considerably. For all general plowing the coulter should be set with the center of the blade directly above the point of the share, and about ½ to ⅝ of an inch to the land. It

should also be set as deep as possible, care being exercised, however, that the hub of the coulter does not drag on the ground and gather trash and perhaps clog, particularly if the ground has been spread with straw or manure.

Coulters containing wood, chilled iron, or steel bearings often wear and get very wobbly, hindering the work of the plow. The best work is done with a coulter which runs perfectly true. This part, then, should receive the attention of the plowman. If worn bearings cause the wobble, replace them; in any case, watch them closely and oil them frequently during the day.

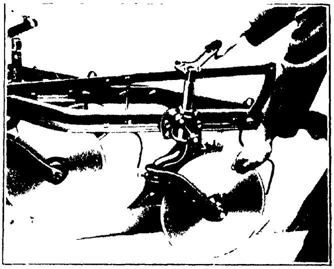


FIG 18 Coulter setting Placing a ¾″ board between landside and coulter blade permits of good setting

When anti-friction bearings are used in the coulter they need no special attention They assure a true running coulter and good coulter performance with a minimum amount of wear. However, they should be taken apart and cleaned thoroughly with kerosene once a week and repacked with good cup grease Grease that is used for wheels of automobiles is satisfactory. Even transmission grease is good, but be sure in any case that it is a first class lubricant.

Independent Beam Plows -These plows are usually made with a minimum of five or six bottoms. They may be made in sections of six, eight, ten, or twelve bottoms each, so that when coupled up in a unit for field use they may have as many as twenty or twenty-four bottoms. The size tractor, the soil conditions, and the size farms to be plowed, determine this. The eight and ten bottom gangs are the most common for the larger tractor outfits These large gangs may be power

or lever lift. The latter, of course, means hand lift. On the former, power is taken from a wheel which by a system of gears and cams raise the plow out of the ground. This saves the hard work of the man who tends the plow and it is a time saver too. Bottoms in these two types may be provided to suit soil conditions. What has been said above on the subject of plows and plow bottoms will apply to this type also.

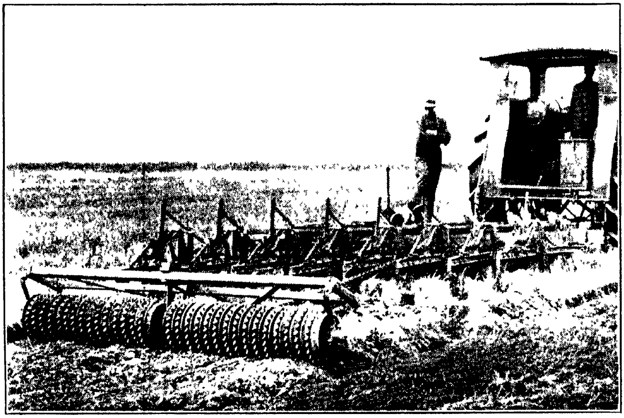


FIG. 19.—An independent-beam plow with soil pulverizer.

These plows, however, need some special care and adjustments different from the others to get good results These plows are usually shipped "knock down." That is because bases and frames are entirely separate and of considerable size. They must, therefore, be set up for use. Added to that, they must be finally adjusted in the field. These adjustments are for depth, for correct width, and for correct horizontal and vertical adjustments, which means levelling them. The functions are of course those of all plows. Bottoms of the variety mentioned above are generally used also.

Hitching.—What has just been said above about hitching rigid beam plows applies to these larger units also. However,

there is not the danger of trouble due to misalignment, side draft, etc., that is so common with the other plows, because these units are usually so much wider.

The crossed chain hitch shown in the illustration will be found satisfactory. The thing to be sure of, is to get the chain long enough so that turns can easily be made. If the tractor has a high draw bar, there is a tendency to lift the front end of the plow gang. This is remedied by merely lengthening the chains, and if the tractor draw bar is adjustable, by lowering it to about 16 or 18 inches from the ground. But the best results are obtained by hitching as closely as possible. An "A" hitch may also be used, but is not so convenient for turning.

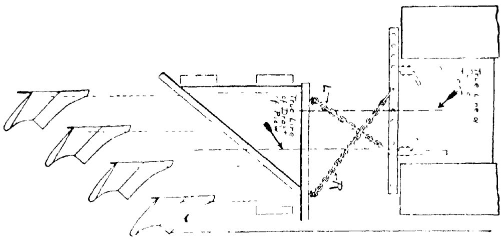


FIG. 20.—Cross chain hitch for independent beam plow.

Adjustments.—Since the beams are independent, each one, often as many as twelve, should work in harmony with every other one. The first adjustment to be made is the suction of the plow bottom. Suction is provided on the standard, which is usually of cast material and hinged to the plow beam at the rear upper end Generally a wood or cast-iron breaker pin is furnished to allow the plow to trip and to swing back if an obstruction—such as a hidden stone or stump—is encountered. Extra break pins of wood or iron should always be carried in the tool box of the plow. If new ones are homemade, be sure that they are exact duplicates of those originally furnished with the plow. Never substitute a bolt or anything

else for this safety measure; it is placed here for protection and should always be used. Be sure that when wood break pins are used all are of full size. Frequently one will be one-half or three-quarters sheared before it is noticed, giving the plow too much suction and putting a heavy load on the gage wheel The plow then tends to run deeper than other plows, wears, and adds considerably to the draft, besides doing poor work. The plows are usually set for correct suction but this should be checked on a level floor or paved street that has a smooth surface.

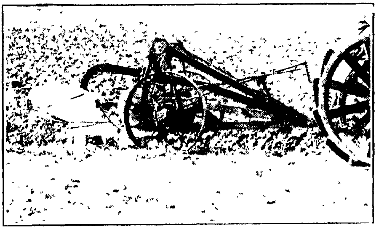


FIG. 21.—Two-way plow for hillside work.

After getting these plows set up, it is well to oil thoroughly all moving parts—particularly the truck and gage wheels—and start in the field. The first thing to do in the field is to set the levers for the desired depth. This can be done easily and quickly. It is important in this work that all plows are working at exactly the same depth, which is governed by the gage wheels.

After such adjustment for depth and suction is made, adjustment for true running should follow. Adjustment for true running is important, because otherwise the plow tends to swing to one side or the other. Bumpers are usually provided to prevent interlocking of the beams. Proper adjustment will reveal that each plow follows the tractor in a true line, and does not crowd the adjoining plow. In making the adjustment, look at the front end of the beam; this is where the beams are hinged Two set screws are often provided, with a lock nut. Set these to make the plow run true. Loosening or tightening one or the other will do this. Sometimes a plate with slotted holes, through which bolts pass, will be found

here, but the adjustment is one of moving one end or the other forward or to the rear In this same place, too, are provided the means for adjusting the plow horizontally, in which direction it is equally important that the plow run true—that is, level. Set screws or slotted holes are used here for setting each gang or two, as the case may be, so that they work in a horizontal or level position. The plows do their best work and at the least expense of power when running true lengthwise and setting square, or true, horizontally. Adjustment to this end can most easily be made with the outfit in the field. Careful observation will reveal whether the plows work well. If they show a tendency to crowd one another, or the outside plows seem to run away from the rest, then there is incorrect adjustment at the place mentioned.

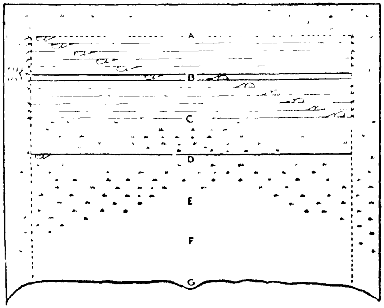


FIG. 22 Plowing in lands and around back furrow as at B and D.

Gage Wheels.—The gage wheel serves to govern the depth of plowing and carry the plows when out of the ground. The independent beam type of plow requires a gage wheel for this purpose. Each single bottom, or sometimes a set of two, is carried by one gage wheel.

The gage wheels need particular attention. Carrying a big load, as they do, and being located in a rather inaccessible place, they rarely get the attention they actually require. They are acted upon by the plow-lifting mechanisms. In some instances this lifting device is contained within the gage wheel itself, particularly the power lifting type. This heavy duty, therefore, calls for special attention to the work of lubricating

these gage wheel axles, because they are usually quite small, and work in a dusty place, and unless they are well oiled, wear out rapidly, causing poor plowing. It would be well to oil all the gage wheel axles at least every few hours during a day. Those gage wheels which have anti-friction bearing equipment, should be greased each morning before starting the day's work, and thoroughly cleaned and repacked with grease once a week. If felt packing is worn, it should be replaced, and if oil grooves are used, these should be thoroughly clean and free from dirt. What is said about the care of coulters under this subject, in a previous paragraph, will apply here too.

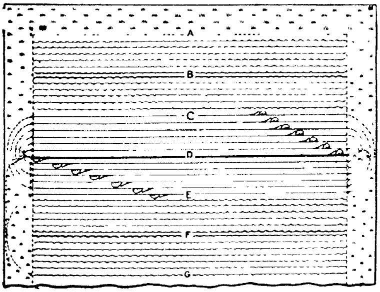


FIG. 23.—Plowing in lands around a dead furrow as at B.

Plowing Fields.—There are endless ways in which farm lands may be plowed by the tractor. Any particular way that is followed may serve as a means to do the job of plowing in a satisfactory manner. Custom is an influence in every particular locality. Many farmers, therefore, do this work as it has always been done.

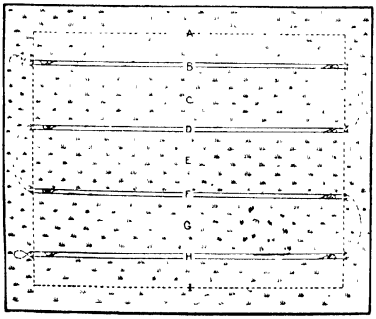


FIG. 24.—Entire field laid out and plowed through in a series of back furrows in one trip over and return.

In general, there are two particular methods of laying out

fields for plowing with tractors. One of these is laying out the field to be plowed up in a series of "lands." These lands may be large or small, and, therefore, make the number of back furrows and dead furrow large or small In this method, the plows are lifted at the ends of the lands while the tractor travels over the headland. The other method is plowing around the field continually, in which case the plows are left in the ground all the time. In this latter method, plowing may be done from the center of the field out or from the outside edge in toward the center.

The first consideration in any case should be thoroughly good plowing. In other words, the quality of the work should receive first consideration. This may successfully be done regardless of the manner in which the fields are plowed. Covering the greatest number of acres in a day is an item that must be considered seriously, because it makes for economical field work. The size of the outfit and the size of the field to be plowed are factors that must be taken into consideration The character of the land, whether hilly or level, is also an important factor.

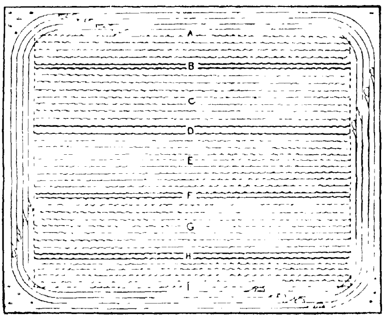


FIG 25.—Plowing headlands. Corners may be cut enough to give easy turn and plow out well.

Plowing fields "in lands" is perhaps the more general practice. This is due largely to the fact that when horses were used this custom prevailed. Investigations made by agricultural engineers reveal that when this method is used about 8% of the total time in the field is occupied for turning and traveling on the headlands. In

other words, 1/12 of the time spent in the field is not used for plowing.

Plowing fields in the other manner, keeping the plows in the ground continually, means that actual plowing is done continuously, with no time lost for travel on headlands.

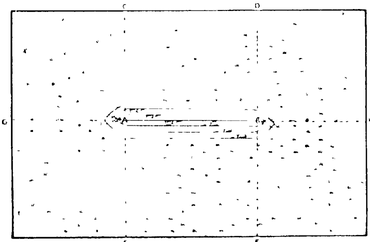


Fig. 26. Plowing around one single back furrow. Plows left in ground in turning corners.

Farmers Bulletin No. 1045, published by the United States Department of Agriculture, shows many different plans of laying out fields for plowing with tractors. Figures 26, 29 and 31 represent three of these different methods for plowing fields where the plows are kept in the ground continually. Figure 31 shows an irregular field. All fields of this nature, whether of a regular or an irregular shape, may be plowed by keeping the plows in the ground continually. When such methods are used, the corners usually do not plow out full, and it is customary to run diagonally across the field to clean up these corner turns. This method permits plowing all the time without losses on headlands. It affords a plan for doing the greatest amount of work in a day. This is due to the fact that plowing is going on all the time. Where the farmer can carry out such a method and accustom himself to this plan

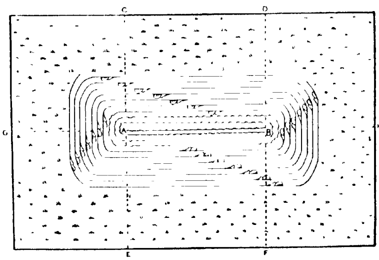


Fig. 27.—Center dead furrow in field laid out to come out even on all sides of field.

it will be found the best one for fields of any shape, regular or irregular, level or rolling. It is well that this be given serious consideration

Some of the most successful mechanical-power farmers are using this latter method in their plowing—plowing from the center out one year and from the outside in the next year, to keep the land level They have found that they can do more work in that way, and pack the ground less than by plowing in any other manner which might call for driving the tractor over the headlands a good many times.

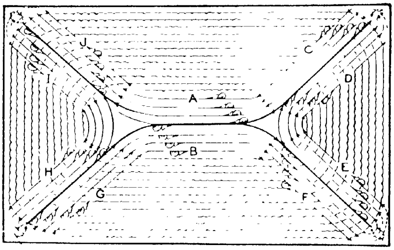


FIG. 28 Plowing diagonal strips when plowing was started at outside, working toward the center of field

The illustrations and this information may be used in laying out fields for work of this sort. Harrowing can also be done in a continuous manner; and if it is necessary, and power available, a harrow may be run directly behind a plow in a field that is big enough for the use of such combinations.

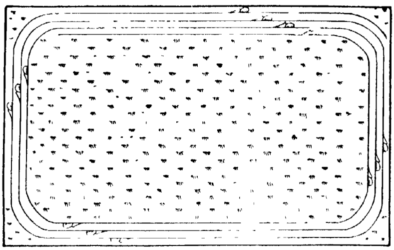


FIG. 29. -Starting at outside of field and working toward center.

Capacity.—The rate of travel and the constancy of work are the two biggest factors in the capacity per plow for tractor work. It is obvious that if a plow is kept going all day, more can be accomplished than if frequent stops are made. Such stops

may be due to tractor trouble or to plow trouble. Then, too, they may be due to turning on the headlands. While turning on the headlands is literally not a stop, yet the process of plowing is delayed. It is clear that the shorter the fields the more time will be spent turning about on the headlands. If a single "14" bottom were kept plowing continually for a ten-hour day, at a rate of three miles per hour, 4.24 acres could be plowed A two-bottom plow would cover 8.48 acres, a three-bottom would cover 12.72 acres; a four-bottom plow would cover 16.96 acres, and a five-bottom plow 21 2 acres.

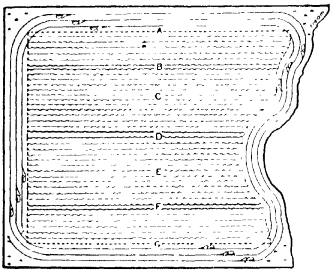


FIG. 30.—Plowing irregular fields in lands

From bulletins issued by the Department of Agriculture * it has been found that the average day's work of plowing in different localities in both spring and fall work is—

6 3	acres per day with	2 bottom gangs
7.77	" " " "	3 bottom "
10 43	" " " "	4 bottom "

The figures here given were undoubtedly gathered from farmers who plowed "in lands." It is certain that by plowing around the fields continually as mentioned above that these capacities may be materially increased

The figures represent averages, which are being obtained in actual practice. From the theoretical day's work, at 3 miles per hour, it is plain that the average tractor in practice, with a two-bottom gang plow, does 2 18 acres less, whereas with a 3-bottom gang plow, 4.95 acres less are done. This is accounted for by frequent stops and turning on the headlands. If the operator of this outfit will, therefore, carefully

* Bulletins No 1004, 1093 963, 719, 1035, 814 and 997.

analyse his fields as shown in the paragraph on "Laying out Fields," it is evident that there is an opportunity to increase the usefulness of such an outfit considerably

The plan of plowing lands where the tractor is kept going continually and replowing the corners when finished should be an aid in getting maximum capacity out of an outfit. Since the quality of the work is in no way reduced, it should be the purpose of every power farmer to remember this, and work accordingly The method may be used in field of any shape, working out just as well in square and rectangular fields as in triangular and irregularly shaped fields. Creeks, gullies, and wood lots frequently account for irregularities in fields, and this method will fit in well for capacity work in plowing with the tractor.

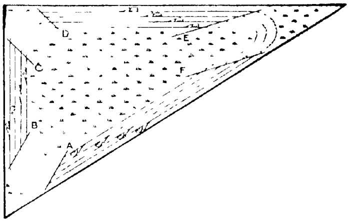


FIG. 31 —Plowing irregular fields with continuous method.

Draft.—The following table gives some figures on the draft of plows covering some five hundred tests of plows made during the past seven years. These figures, therefore, present averages on many tests made in practically all our grain growing states, and in Canada Averages are given and the results of tests in each case are clearly shown The figures do not account for improper hitching Hitching is an element that materially affects the final results.

DRAFT PER SQUARE INCH OF FURROW SECTION

Sandy soil	3	Pounds
Sandy loam moist	3–4	"
Sandy loam dry . .	4–6	"
Sandy clay loam moist	5–6	"
Sandy clay loam dry .	6–7	"
Clay loam moist . . .	6–7	"
Clay loam dry	7–8	"
Heavy clay dry	9–10	"

DRAFT PER SQUARE INCH OF FURROW SECTION—Continued

Heavy clay sod	10–11 Pounds
Virgin Prairie land—clay moist	12–13 "
Virgin Prairie land—clay dry	14–15 "
Gumbo moist	16–18 "
Gumbo dry	16–20 "
Dry adobe	20–25 "

From this table one can readily understand why some tractors, in certain localities, pull plows with ease, while in others this is a difficult job. If the operator of the tractor will familiarize himself with the soil conditions under which the tractor is to work, it will be much easier to appreciate what he may expect in the way of performance with his tractor and plows, and also whether it is best to use a plow with two 14-inch bottoms or two 12-inch bottoms, or even a plow with one 16-inch bottom. A fact that should not be lost sight of is that plowing up a grade with the tractor will take considerably more power than running on level ground. A good rule to follow is to add 1% of the tractor's weight for every 1% in grade to the draft of the plows as figured out from the table given above. With a tractor of 2800 pounds weight, therefore, going up a grade of 3% (3 ft. in 100 ft.) 3% of the weight or (3×2800 pounds) $= 84$ pounds, should be added to the draft of the plows, as figured from the above table to suit the soil that is being plowed.

Field tests reveal the fact that improper hitching can add as much as 34% to the draft of a plow on a three-bottom tractor-gang. Added to this is the fact that poor plowing is bound to be the result of such hitches. Poor plowing not alone adds draft, which means added expense because of the increased fuel used, but jeopardizes the crop yields, which means a loss in output and consequently reduced income. This is vitally more important.

According to Prof. J. W. Sanborn, a plow will show its lightest draft when set to cut the widest furrow of which it is capable. He also states that 42 per cent of all draft is used up by the share and the landside.

At the Utica trials, conducted by the New York Agricultural Society, it was found that 55 per cent of the draft of a plow was caused by the cutting of the furrow slice, 35 per cent by the friction of the sole of the plow, and 10 per cent by the work of lifting and turning the furrow.

Sanborn also made some tests to determine what effect a rolling coulter had on draft and the following table shows his results. A plow similar to a sod breaker plowing two-year-old clover sod.

EQUIPMENT	SIZE OF FURROW	TOTAL DRAFT IN POUNDS	DRAFT PER SQUARE INCH FURROW SECTION
Sod plow with wheel coulter	5.575" x 15.08"	296.25	3.524
Sod plow without wheel coulter	5.325" x 14.5"	343.75	4.453
Difference		47.50	.929

This shows that the coulter reduced the draft 20.86 per cent and added to that did a better job of plowing.

In a series of tests conducted later on soil that was considerably drier than before, the following table shows the results:

EQUIPMENT	SIZE OF FURROW	TOTAL DRAFT IN POUNDS	DRAFT PER SQUARE INCH FURROW SLICE
Sod plow with wheel coulter	6.17" x 11.61"	714.35	10.80
Sod plow without wheel coulter	6.413" x 12.17"	664.82	8.616
Difference		49.53	2.184

In this the use of rolling coulters reduced the draft 25.34 per cent per plow.

In a series of tests made at the Ohio State University to get a comparison between the draft of a disc plow and mold-board plow under the same conditions, the following data were obtained:

PLOW	SIZE OF FURROW	TOTAL DRAFT IN POUNDS	DRAFT PER SQUARE INCH OF FURROW SECTION POUNDS
Mold-board	12.7″ x 6.93″	526.7	6.98
Double Disc	10.4″ x 12″	785.4	6.29

This shows a slight saving in power. In general, however, the fact that a disc plow may go into a certain land and do the work that a mold-board plow might not do, even at considerably more expense of power, would make it well worth while. Therefore, comparisons of the power required to plow with a mold-board and disc are not so important.

It is well to remember that reduced draft—or perhaps it should be termed "light draft"—does not always mean good plowing. Good plowing will require more power than poor plowing at the same depth and in the same soil. Two plows of different make, plowing the same depth, the same width, and in the same soil under identical conditions, may show a vast difference in draft per square inch of furrow section or per bottom. It is well to remember that to make comparisons at all it is necessary to have like conditions. Plowing is important and deserves a great deal of consideration from the operator of the tractor and of the plow. Good work should always be the first consideration.

The Disc Plow

As previously stated, the function of disc plows is the same as that of the mold-board type. They are, however, of more recent development and considerably different in design and construction.

Types, Sizes, and Rating.—The most common type are lever or hand lift, and automatic or power lift. The former is the earlier type. To do away with the necessity of an extra man on the plows, the power lift was developed. By

the aid of a lifting device, driven from one of the wheels, usually the land wheel, the tractor operator can control the "lifting-out" of the ground or "letting-in" of the plows by merely pulling the trip rope.

Disc plows, like mold-board plows, are rated in sizes by the number of discs there are in the plow gang. These discs vary in diameter on different makes of plows from 24 inches to 28 and even 30 inches. The most common size, however, is 24 or 26 inches in diameter. This would permit plowing to a depth of 13 inches. The width cut by a disc plow is less

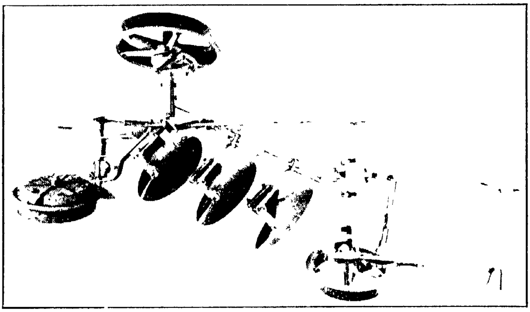


FIG. 32. Top view of three-disc power-lift disc plow

than by a mold-board plow, and varies from 6 inches to 10 inches. Some makes may even be set to cut a wider or narrower furrow. The most common width, however, is 8 inches. Disc plow gangs for tractor use, like mold-board plows, may be had in sizes ranging from two discs to eight or ten. The three and four disc size is the most popular and on this size an extra disc may often be attached when plowing conditions will permit. Disc plows, therefore, are rated as two-disc, three-disc, four-disc, etc. Unless specially noted, the discs would probably be 24 or 26 inches in diameter. There are slight differences, but only in such items as apply to each manufacturer's designs.

Hitching and Field Operation.—It may be seen from the illustrations that hitching disc plows is considerably different from that of any other type. In the first place, the shape of the furrow cut is different. It has a round bottom as illustrated. Most disc plows may be set to cut 6, 8, or 10 inches wide. This does not necessarily mean a corresponding differ-

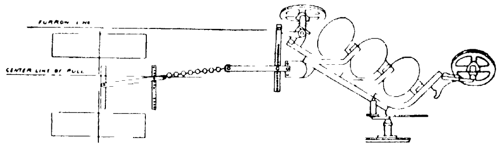


FIG. 33.—A good hitch length for three-disc plow.

ence in depth. Depths are secured by lever adjustments and the use of disc blades of different diameters.

The width of the furrows is usually measured from peak to peak at the bottom. The depth is usually measured to the bottom or deepest part of the furrow. The width cut is usually determined by the power available or the hardness of the soil. If, therefore, very hard soil is to be plowed, less

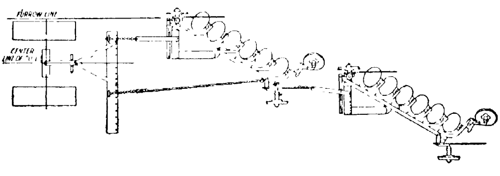


FIG. 34.—A hitch with wide drawbar for two gangs of six discs each.

width should be used to reduce the draft. It will also do better work because each disc will have less ground to plow. On practically all modern disc plows there is provision made for varying the width of cut. Usually a series of holes or notches on the main frame allows for this. Frequently they are marked to facilitate this work. It is rarely necessary to

change a setting after the correct or most practical width has been determined by field work. This, of course, depends, as said above, on soil conditions with reference to hardness or power available.

The center line of draft on a disc plow falls considerably nearer the furrow wall than on a mold-board for the same number of plows. This is due to their peculiar action in the soil and also the narrower width which they cut. As said before, the width cut is small because of its considerably harder or heavier draft, occasioned by the soil conditions in which disc plows are to be used. On a plow, however, of 4 discs cutting say 6 or 8 inches wide and 10 inches deep, the center line of draft would be approximately 9 inches from the edge of the preceding furrow, but this is not a set figure. It will change with the hardness of the soil, with the pounds pull, therefore. Then, too, the angle at which the disc is set has an influence. The tractor operator, however, will easily find the exact place on the plow to which to couple his draw bar or chain. If the plow tends to "tail" that is, if the rear part creeps toward the land and out of the furrow—it will be necessary to hitch nearer the land or the right-hand side of the plow. The reverse is true if the plow "tails" toward the plowed ground.

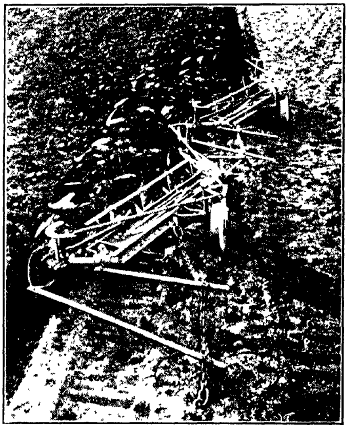


FIG. 35—Front view showing hitch of two gangs with single chain. Note steering drag link for front furrow-wheel

The point of hitch on the tractor draw bar, if it can be set, should be considerably lower than when mold-board plows are used. Usually, from 10 to 12 inches in height from the ground will be found satisfactory. If the tractor draw bar will not allow such low hitching, it may be necessary to lengthen the hitching bar or chains considerably, particularly in deep plowing. It is a good rule to use as short a chain as possible and hitch it as close to the center of pull on the tractor as consistent. The ordinary length required with a tractor draw bar height of 10 or 12 inches will be about 48 or 50 inches long, which will permit easy turning and, in general, prove very satisfactory and practical.

The rear furrow wheel serves as a steadying member in plowing. It should set so that it holds the plow in true running line. In other words, the disc plow, like the mold-board type, should run true and straight. The best way to test it is to observe that the land wheel runs perfectly true. This should not show any sign of an angle Skidding action of the plow instantly reveals improper adjustment somewhere and this land is a good "tell-tale." Often the rear furrow wheel has a set screw adjustment that permits giving it a little "lead" away from the land. If carefully set, it will help to keep the plow running correctly. Under no circumstances should this rear furrow wheel lead toward the land. It should be set very carefully to get it to work properly. This is particularly true and noticeable when plowing a land with a continuous furrow around the field.

The front furrow wheel should also be set to run true. It requires only a very little to steady the plows and help them to run true. Never have any "lead" on the front furrow wheel away from the land, or else it will be hard to keep the plows operating correctly. It may be necessary, due to very hard plowing, to lead this wheel considerably and in such cases it should be toward the furrow wall. This adjustment usually is made by a drag-link or bar which is coupled between the wheel spindle itself and the draw bar or draw

chains. This, it will be seen, is also the steering device for the plow, and keeps it following the tractor properly, a matter of importance, particularly when plowing around and around a field continuously. A proper hitch on the drawbar, however, will eliminate any tendency of these wheels to work either to or from the land The perfect hitch will force the plow to run exactly straight In such cases, these wheels, with the land wheel, will have only to support the discs to keep them running at a uniform depth.

Owing to the fact that the power lift disc plow has so many more pieces and parts than the lever lift, more adjustments need be made. These various joints are all fitted, and unless every part is kept securely bolted the rigidity is considerably reduced Care should be exercised, therefore, to be sure that all bolted joints are always very well secured and tight. It is important to see that this type plow is always running level. The rear wheel should be set properly so that the spring in these various parts when under load does not throw the plow out of line enough to prevent its proper work. The vertical hitch on disc plows should be considerably lower than mold-board types.

FIG. 36 --Furrow disc-plowed

When several gangs are to be hitched behind the tractor, a hitch, such as here illustrated, is desirable. It will complicate matters to hitch with gangs, yet when the lands are large and the power is available, it can be done successfully and economically. The whole problem is after all one of final results. Since the disc plow is made for difficult plowing jobs, one gang instead of several is most commonly used. Furthermore, it is desirable because of the hitching problems.

The hitching has an influence on the turning, which complicates matters instead of simplifying them.

Many times the farmer will find plowing so difficult that it is almost, and often it is, impossible to keep the plow in the ground. It will jump out continually, particularly at the rear end. It may be said that ground as hard as this should not be plowed, yet plowing must be done. In such cases weights may be added to the rear furrow wheel. Even a special extra heavy wheel, plus the weights, is sometimes necessary. On some plows as much as 500 pounds extra weight is added to help hold the plow in the ground.

FIG. 37.—A single four-disc plow. Note rear furrow-wheel leading away from land.

In most localities where discs are used, plowing may be done, in lands, by methods similar to those used in mold-board plowing. Where large areas are to be plowed, continuous plowing is best. The most common method is the turning to the left. This necessitates beginning at the outer edge of the field, and gradually working toward the center. Turning the corners means of course running up on the plowed ground with the tractor, in order to have the plows cut out the corners. Even if this method is used, it is desirable to plow through the field diagonally, to plow the corners thoroughly. By using the method of starting in the center of the field and working outward, it is customary to turn to the right. In this

method the tractor does not need to travel on the plowed lands when turning. It is customary to begin just as when plowing with the mold-board plows, looping at the end until sufficient land is available for continuous going It will be necessary to plow through the corners diagonally to be sure all the land is thoroughly plowed and ready for the disc harrow.

Scrapers are usually furnished with all disc plows. These are of various shapes and designs Their purpose is to scrape the plowed furrow from the disc and help turn and pulverize it in soils where this is necessary. Sticky or waxy lands will not clear the disc without the aid of the scraper. In such lands a scraper should be carefully adjusted as to height and angle. The greatest risk lies in setting the scraper so low that it will increase the draft of the plow considerably, due to the fact that the scraper tends to remove and turn the furrow too low on the disc. This point is important and needs special care. A good rule to follow is always to set these scrapers as high as possible and still permit them to do their work of cleaning the disc blade and turning the furrow slice. In some dry or hard land plowing, the scrapers may be removed entirely. Here they will be found really to hinder good pulverizing by their action on the furrow slice. If it is possible to do good work without them, they should by all means be left off. In many cases where plowing is done at a rate of travel of from 2½ to 3 miles per hour, the scrapers will prove of no value. In such instances the draft of the plow will be materially lower than when they are used.

Capacity.—The amount of work that may be done in a day with a disc plow, like that of a mold-board plow, depends on the size of plows used (width cut), the rate of travel of the tractor, and on the size of the lands being plowed It is safe to say that on an average of from 1¾ to 2 acres per day may be plowed per disc, cutting 7 or 8 inches wide. This is from 3½ to 4 acres for a two-disc plow, and from 5¼ to 6 acres for a 3-disc plow, 7 to 8 acres with a 4-disc, 8¾ to 10 with

a 5-disc and 10½ to 12 with a 6-disc plow. This accounts for a rate of travel of about 2½ miles an hour, and in average sized lands as will be generally found in localities where disc plows are used. Since plowing with these plows is done under unusual conditions, it will be safe to assume that the rate of travel will rarely exceed 2½ miles per hour for disc plowing. When power is available and conditions favorable a speed of 3 to 3½ miles an hour is desirable.

Draft.—Since disc plowing is usually done in localities where the ground is very sticky as well as where it is very dry and hard, it follows that the draft per plow, or per inch of furrow section turned, is greater than in mold-board plowing. In sticky or so-called wax lands, the soil is damp and heavy; and while it is really more a question of proper scouring, the actual draft per square inch of furrow section is about that given for gumbo in the table on page 29.

Dry adobe may, at certain times of the year, and in certain localities, show a draft of at least twice or three times that given in the table. It is safe to assume that in general the figures given in the table will apply to disc plows as well as mold-board plows. The type of plow has less influence than the type of soil.

Repairs.—Since the share is the "business end" of the mold-board plow, and since it does the most work, it usually wears the most. The treatment given worn shares depends on the material from which they are made. Soft center steel shares are most commonly used. Soft center steel, as explained previously, is made of two pieces of crucible steel welded to each side of a center piece of low carbon soft steel. The two steel materials are about $\frac{3}{32}$ of an inch thick, while the center is about $\frac{3}{16}$ of an inch thick. This gives a material that can be bent to the shape of a share or mold-board, and hold this shape, while the outer layer of steel is hardened or tempered to a glass hardness. In manufacture they have a crucible steel piece welded to the point, as shown in Figure 6 at B. This adds extra steel where the wear is most severe.

Shares also wear away rapidly along their edges and at the wing. Crucible shares are made of a piece of crucible steel throughout. It is a solid material and takes an extremely hard temper. In this case, however, it is provided with the additional steel point, as in the soft center shares

Sharpening the Share - Figure 40 shows a badly worn soft center steel share. To get this re-pointed and sharpened calls for able blacksmithing Whether this work is to be done by the farmer, in his own repair shop, or by the regular smithy, it must be done correctly. One of the best ways is to get a plate of crucible steel and weld on, as shown. By following this method, the worn share may be sharpened--or pointed, as it is often termed—and brought back nearly to its original shape. An old rasp makes a good plow point. It may be seen by first drawing the temper and bending it, as shown, how well the rasp lends itself to this work. To weld it to the share is the object. The handling of such work is beyond the purpose of these chapters. The purpose, of course, is to get as near the original shape as possible, and to draw the outside or hard steel pieces over the soft center and properly weld them so that when hardened they present a hard sharp cutting surface to the ground. The number of times a share should be sharpened depends on the soil in which it is used. Dull shares should never be used.

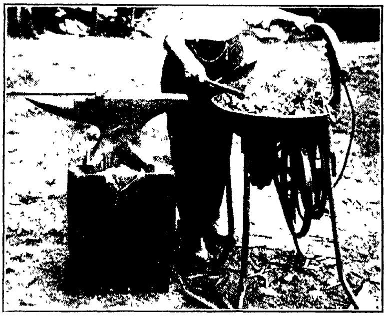


FIG. 38.—Heating a share, preparatory to hammering edge for sharpening.

Crucible shares are preferably used in gritty sand and such soils as would wear away the outside of soft center stock

too rapidly. To sharpen, or point, they may be heated and drawn out on an anvil. Cast shares with chilled surfaces and edges are also for use in such soils, and are even harder than crucible shares. They require grinding to sharpen them only. A grind-stone or emory wheel will enable the operator to do this satisfactorily. They cannot be hammered at all. Their use is confined to soils where either of the other types would wear away too rapidly to be practical.

After a soft center share has been re-pointed and a chilled surface re-sharpened three or four times, it will be impossible to get anywhere near its original shape and it must be replaced by a new share. Great care should be exercised in doing this work to be sure that the suction and the land of the share are the same as when the share was new.

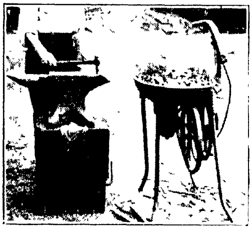


FIG. 39.—Hammering soft-center steel share for sharpening.

The illustrations show a few steps in this process of sharpening plowshares which may help one unfamiliar with the work. Slight variations in the way of doing it will always be found. Experience will reveal the easiest and best way. Tempering is important, of course, and must be very carefully done to insure a hard surface. To test the hardness is also important. By breaking the corner off an old file and using its sharp edge on the surface of the share, the hardness may be tried. The sharp corner of the file, when pressed as if to scratch the surface, will slide over it as though on glass. If, however, there are any soft spots, the file will instantly stick and dig into them. This is a fine test to determine the surface hardness of any plow bottom. These surfaces should be hard enough so that the file will not take hold, but slide around very easily without any tendency to stick. After the share has been hardened—or tempered, as it is very often termed—

it should be ground and carefully polished. To get a good clean, smooth surface such work should be painstaking.

Sharpening the Disc.—The disc plow blade, like the share of a mold-board plow, should be sharp to do good work. The best method of sharpening it is to roll the edges. The sharpening angle should always be on the outside, so that it will cut clean and do it in the easiest way. If the edge must be sharpened by grinding, the grinding should always be done on the outside of the blade. When grinding is done, care should be exercised to keep from heating the blade, because this softens the metal by drawing any temper it may have. Rolling, however, is preferable and wherever facilities are available, this should be done, because in this rolling process the metal is compressed, giving decided tendency to harden the cutting edge of the disc blade.

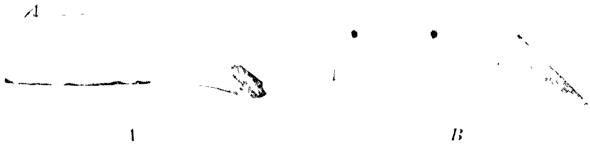


FIG. 10.—*A*, Badly worn soft-center steel share; *B*, Re-sharpened soft-center steel share.

Patching the Mold-Board.—If the shin of the mold-board has been worn away, a new patch of crucible steel or a piece of file steel should be welded on the worn place. Care should be taken not to disturb the shape of this mold-board, or it may prevent the proper working of the plow. The mold-board should then be ground at this repaired place and polished very carefully to get a smooth surface.

Straightening the Beams. This, too, is an expert's task and should be very carefully done. The eye is the best straight edge and will reveal just where the beam must be hammered to get it straight. A very low heat should be used to be sure that the beam is not injured. Usually only

one beam of a two- or three-bottom plow needs straightening. Therefore, it is always a good plan to see that the repaired beam is exactly like the others on the plow—this refers to the bend of the beam—and unless it is done and all beams are exactly alike, the one-bottom may not work well In fact, it may throw out of action the others whereby only one, two, or three are used. Particularly is this true where it is set too deep.

Since sharp plowshares have been so strongly recommended in the chapter on plows, the following data, by Sanborn, are given on this subject

In a series of tests it was found that an old share repointed and sharpened by a smithy showed a difference in draft of 6.7 per cent in favor of a dull point on the same plow, but an advantage of 36 per cent in favor of an entirely new share over the resharpened one.

Hence the importance of having the proper shape and edge on the share. It illustrates very clearly how much power may be entirely lost due to dull shares on plows. Another good example may be cited which is worthy of some consideration. During the summer of 1909, at the Winnipeg Motor Trials, two plows of six bottoms each and of the same make and the same style of bottoms, presumably cutting the same depth in the same soil and on the same day, showed a difference of 45 per cent in draft The difference was attributed mainly to the fact that one was a new plow with new bottoms especially sharpened, while the other had been used for several months previous in plowing hard stony land.

LISTERS

Function.—The lister is, to all intents and purposes, a plow. It has all the characteristics of the plow and is used for the same purpose as a plow. Therefore, what has been said about the functions of the plow and about plow materials and care will apply equally well to listers.

Figure 41 shows that a lister is practically a double plow. It will be noticed that there is a mold-board and share on each side of the center.

The use of this machine is confined to localities where the ground for wheat, cotton, or corn is listed. Such localities are often semi-arid, and the purpose of planting the grain in listed rows is to make it possible for the ground to gather the moisture in the furrow where the seed is to be planted, to render it less likely to blow during windy weather, and to facilitate bringing the ridges down onto the roots of the plant during cultivation to get them well covered and to conserve moisture by the mulch.

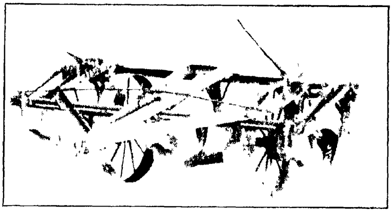


FIG. 41.—Three-bottom tractor wheat-land lister.

Types and Sizes.—Practically the same style of lister is made by each of the various manufacturers, although each machine has characteristics of its own. Machines are made that will plow either a single row, or two or three rows. Multiple-row machines are made with settings that allow rows to be planted from 36 to 48 inches apart. Adjustments can be made which will permit this. The choice of one or the other depends on the fertility of the soil. Machines of lever lift or power lift are procurable. The power lift, two- or three-row lister, is considered most practical for tractor use. Machines having provisions for planting either cotton or corn may be procured. The difference is in the planting device only.

Hitching.—There is a considerable difference between the hitching of a lister and that of a common plow, in that the lister has no side draft. This machine is made with a double mold-board, and the center line of draft is midway between

two bottoms on a double machine and directly in the center o one mold-board on a single-row machine and on a three-ro machine. For tractor use, this machine is very often mad with power lifting devices that may be operated by the trac tioneer from his position on the tractor. Pulling a trip rop will drop the bottoms onto the ground, and by the same mean they are lifted out of the ground. The machine should b hitched as close to the tractor as is convenient for turning hitched high enough so that it will carry an equal load on al of the wheels which are usually used on a multiple-botton

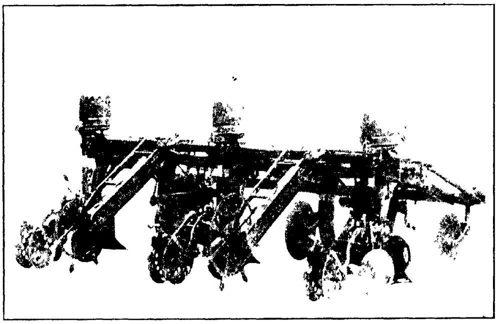


Fig. 12.—Rear view of three-bottom tractor corn lister with plantin device

machine. The description of hitching high and low and th load on the wheels, in the discussion of "Plows," applie equally well here. The question of getting a high or low hitch on the lister, however, has the same effect on it as i has on a conventional mold-board plow. The hitch point or the tractor should always be as near the center as possible.

Field Operation.—This machine is slightly different in fiel operation from the mold-board plow, although the purpos is almost the same. Since it is the custom, when plowing i the Fall, as when plowing in Spring, to open up this fiel in ridges as the lister does, the operator should be particularly

careful to drive as nearly in a straight line as is possible. It makes a better looking job for one thing. In the second place, in many localities such as Texas, Kansas, and Oklahoma, when the work is done in the Summer, it is customary to get out with the lister in the Fall of the year and break these ridges in the middle with "sweeps" to level the land for winter wheat. In West Texas where these original ridges are opened again preparatory to planting corn or cotton this process is

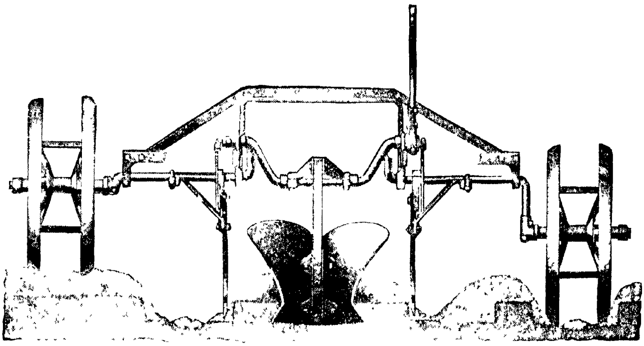


FIG. 13.—Lister showing leveling by means of land wheel.

often termed "Back-listing." This operation is also commonly termed "Middle Busting" and the machine is often referred to as the "Middle Buster."

When single listing in the Spring for corn in Western Missouri, Kansas, and Texas, it is customary to plant at the same time, and practically all of the machines may be equipped with planting devices which drill the corn in the bottom of the rows and cover it. The amount of corn planted depends, again, on the fertility of the soil. Depth, too, has an influence. In many machines sub-soilers are used as an attachment underneath the mold-board to stir up the soil directly beneath where the seed is planted. Care should be

used not to set this sub-soiler so deep that it affects the work of the machine and strains the machine as a whole. One of the first adjustments to make when working in the field is to set the machine to run level, to set it to suit the depth. The adjustment can easily be made by means of the levers provided for this purpose.

FIG. 44.—Lister plow-base

After the seed is planted there are different devices used for covering it. Shovels of various kinds, or even discs, may be used for covering the seed The choice of one or the other depends on the soil characteristics In many cases it is important to see that the covering devices are not set so deep that they will dig up or otherwise disturb the seeds, and that they are not set so shallow that they will not cover properly, or so deep that they will cover too greatly When a disc is used for covering, it should be set so that it will not dig away too much of the ridge, but will cover properly. On many machines of this kind press wheels are used to pack the soil around the seed, but not directly above it. This is to increase the density and to pack the ground for hastening the growth of the seed. The press wheels often form the rear carriage of the machine, also. In most cases they are double, although they have the function of a single wheel. Two sets of them are used on double row listers The scrapers

FIG 45—Lister sweep-base for middle busting

on these wheels should be set very close, so that if the ground is a little sticky it will not build up on the wheel, taking up that dirt which should be used to cover the seed and in so doing enlarge the wheel so as to reduce the depth of the planting. The purpose of the double wheels is to allow a place for the small plants to sprout up on that portion which was not pressed or packed down by the wheels.

FIG. 16.—Listing corn land with two-bottom lister.

The lifting mechanism on the listers should be watched carefully to see that it functions. It needs attention in the way of oiling as well, as do the wheels, which should be greased at least once a day. The seeding mechanism is nothing more nor less than a hopper provided with a series of plates which govern the amount of corn or cotton planted. The plates may be either edged-drop or hole-drop. Various makes of corn planters have different methods of dropping the seed from the hopper to the bottom of the furrow made by the lister bottom. Lever adjustments are provided which govern the depth of listing and planting. After the lever is set, however, the lifting or dropping of the plow back into position will not disturb the depth adjustment. This seeding device is usually driven by a sprocket chain from one of the wheels and axle or both of them and is usually enclosed. However, it requires some care in the way of oiling to see that it operates well

Care of the Bottoms.—Lister bottoms require the same care that ordinary plow bottoms do, and what is said about this in

the previous part of this chapter applies here. Scouring sometimes becomes a factor here, as in regular mold-board plows, and is largely due to the fact that the plowshare is not clean and smooth. Coulters also may be used on these plows.

Care of the Points.—Like those of an ordinary plow, the points of the lister need renewing occasionally. Sharpening will sometimes put them in the proper shape to stay in the ground and bring pressure enough on the plow so that they will

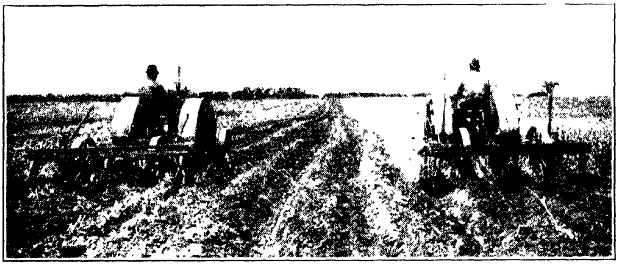


FIG. 47.—Ridge breaking or "middle busting" Listing

scour at all times. Frequently the listers are used at a time of the year when the soil is so moist that no end of adjustments will entirely prevent scouring trouble This may prove that the field is too wet to work and judgment must be used not to work the field under conditions that are unsatisfactory in the operation of the machines. The same holds true of the covering devices, whether shovels, blades or discs. In any case, they should scour and be clean, or they cannot perform their work well.

Care of the Discs.—It is necessary to see that the discs, when they are used as a covering device, are kept well oiled. They have an important function to perform, and should be watched closely. In many cases they become loose and wobbly, due to wear in the bearings, and when this occurs,

the bearings should immediately be replaced because they will not work well in such a condition

What was said above about rolling coulters for plows will apply to coulters for listers as well, except that jointers are never used on listers. The coulters are set directly over the center of lister bottoms.

Capacity.—As in plowing the capacity is influenced by the size of the fields being worked and the spacing of the rows, together with the rate of travel.

Generally, however, a two-row lister drawn by a tractor at about $2\frac{1}{2}$ to $2\frac{3}{4}$ miles an hour in average sized fields will do about 18 acres a day. In exceptionally large fields, 20 to 22 acres may be covered.

With a three-row lister an average of 35 acres a day may be covered in fields of average size, while in large fields and under favorable conditions as much as 40 or 45 acres may be done.

Draft.—The draft of listers, in localities where they are used, is about the same as that of a mold-board plow working at the same depth, under the same conditions. The figures given under this heading in this chapter may, therefore, be used to apply to the power required to plow with the conventional lister. Back listing usually requires considerably less draft because the soil has already been broken up.

Repairing.—Repairs such as may be required for these plows are the same as for the conventional type plow, and the discussion of this subject in the first part of this chapter applies equally well to listers. This is due to the fact that the shares or points and mold-board, together with the knife and shovel covering devices, are usually made of soft center steel. Repairing and sharpening discs as presented in the chapter on "Harrows" will apply to the sharpening of the discs used in the covering device of this machine.

CHAPTER II

HARROWS

Function.—The function of harrows is to break up and disintegrate the top soil, and to help make it mellow. When used after plowing in the Spring their function is to prepare a good seed bed for the grain which is to be planted. If properly operated and adjusted they are capable of producing results of which no other implements are capable, at the minimum expense of time and power. These machines are primarily tillage tools and are used to put the land in good tilth.

Types.—Three common and distinct types or kinds of harrow may be used with the tractor. They are the peg-tooth, the spring-tooth, and the disc. There are numerous modifications of these three types for different localities and different soils. This chapter, however, refers to these distinct styles or kinds and may apply to many of the others. The selection of any one or two is dependent on the soil conditions The combination of implements that are to work with the harrow for soil pulverization will have an influence on the selection of the type. The soil and the crop, too, have great influence.

THE PEG-TOOTH HARROW

This implement is one of the simplest and yet one of the most important of tillage tools. It is frequently termed a smoothing harrow. Its use with the tractor has not been so common as with the horse, because the several units have not been available in sizes and coupling convenient for tractor use.

The implement illustrated is made primarily for tractor

work. Its utility lies largely in the fact that it lends itself to easy handling with a tractor. When it is used with the short evener, two sections may be used, having a width of about 11 feet only, whereas, with three sections, when spread as shown, ready for work, it is capable of covering a width of about $16\frac{1}{2}$ feet. The increased power of the tractor over horses and the size harrow that could, therefore, economically be handled for such work, plus the increased rate of travel, make this outfit valuable to the tractor farmer.

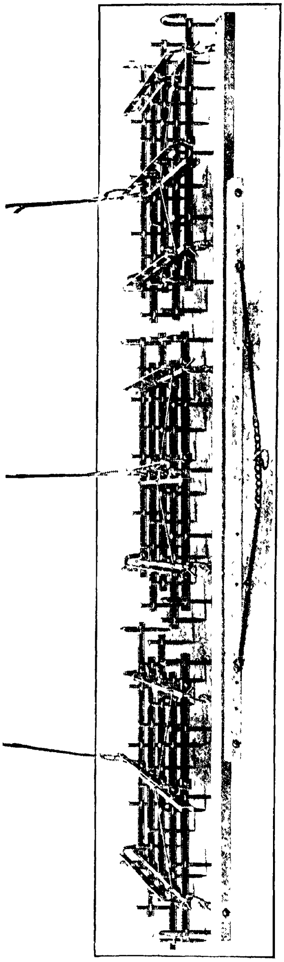


FIG. 48.—Peg-tooth, open-end, three-section harrow with long evener.

Sizes.—Peg-tooth harrows are made up in sections of about 5 feet each. This means that they will harrow a strip of ground this width. The number of pegs or teeth run from about 25 to 35. Each section is provided with a lever for angling the teeth. These sections may be used in groups of as many as practical—usually three or four with the tractor. For work in fields that contain trash, a flexible peg-tooth harrow is desirable.

Hitching.—Only one setting need be made, so far as hitch is concerned, and that is for height. It is merely necessary to observe that the draw bar of the tractor and the point of hitch on the evener of the harrow are far enough apart so there will be no tendency on the part of the tractor to raise

FIG. 49.—Three section, flexible, peg-tooth harrow

the forward end of the harrow from the ground. The hitch chains should be long enough to cause the harrow to hug the ground very closely. The center line of draft of the harrow is fixed and cannot be changed. It will always fall midway between the extreme width, if all the sections have the same angle of the teeth. Care should be taken to have the hitch

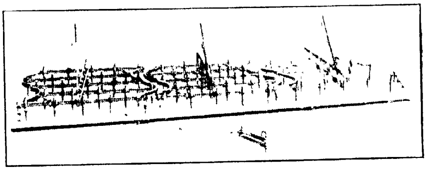


FIG. 50.—Closed-end, three-section, peg-tooth harrow.

chain long enough that when turning the tractor drive wheels do not come within several feet of the harrow itself

There is danger, particularly when extension angle iron cleats are used on the tractor drive wheels, that the wheels strike the harrow on a turn and pick it up. The damage that may be done is easily imagined. Furthermore, if the tractor drive cleats should catch the harrow and raise it, there would

be the added danger of the tractioneer's being seriously injured.

In certain localities where fields are of sufficient size and power is available, it is good practice to hitch the peg tooth harrow behind the disc harrow. The width should then, of course, be the same as the disc. In such cases it is best with to make the hitch directly with crossed rods or chains from the front end of harrow evener to extreme ends of tractor

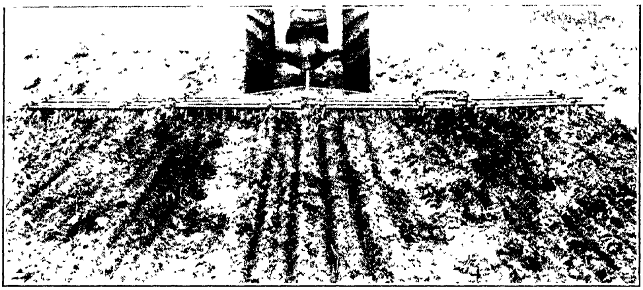


FIG. 51.—A four section, flexible peg tooth harrow hitched to a small tractor.

draw bar. If the tractor has no such draw bar, the draw rods may be secured to the centers of gangs of the disc harrow, and should not be crossed. When four sections of peg tooth harrows are used, the eveners are usually drilled for draw hooks so that the one long evener will accommodate the four sections, but in the case of two sections it is necessary to use the short evener which is provided for that purpose. The long evener will also be found drilled so that three sections may be used without the necessity of boring new holes. When more than four sections are to be used, it is a good plan to make a special evener bar and carry it on a truck or on wheels of some sort. A very long evener will work better if carried that way, and unless it is so carried, it will be dragged on the ground and perhaps be worn out in

a short time. If not worn out, it may wear away enough in places to break later.

Field Operation.—Levers are provided which permit setting or altering the angle of the teeth. The angle may vary from a flat position, slanting rearward, to a position slanting slightly forward. In the latter position the harrow tends to hug the ground very closely. The teeth or pegs of the harrow, too, may be set up or down to the extreme positions. The operator should attempt to have all teeth set exactly alike for depth, or at least staggered if the depth of various teeth must differ. It should be noted that the angle at which the teeth do the best pulverization is the angle at which this harrow should be used. No set rules can be laid down for the work because soil and moisture content will have an effect that governs the angle. In no case should the angle be any greater than is absolutely necessary to do the pulverizing thoroughly. Every section should be set exactly alike so far as the angle of the pegs are concerned. The nature of the soil and the previous work done on it, together with the moisture and the crop to be planted, are all factors that determine angle and depth of the peg teeth. Never should the quality of the work be sacrificed for lack of power. In such cases it is best to remove a section, or even two of them, if necessary, to good thorough pulverization.

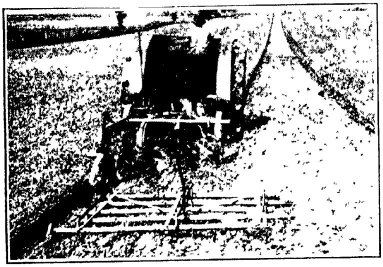


FIG. 52.—A single-section peg-tooth harrow used in combination with a three-bottom tractor plow.

Clogging with trash is the most aggravating part of working with this implement, for unless the implement is kept clean, it cannot work properly. When used with a tractor, therefore, this difficulty requires watching. When used at

higher speeds, there is less tendency to clog, or if it does, it cleans itself far easier than at slow speeds.

The teeth should always be sharp. They may require re-pointing once in a while and this is done by drawing them out on an anvil at a cherry red heat rather than by grinding. They should be hammered to as nearly their original shape and sharpness as possible.

Capacity.—With a tractor traveling at the rate of two or two and one-half miles per hour, it will be possible to cover about 12½ acres per 5-foot section in a day of 10 hours. In other words, about 2½ acres per foot of width is considered an average day's work. Where the tractor can travel faster—and it is possible in the majority of cases with the smaller sized machines to travel say three or three and one-half miles per hour—as many as 3 acres can be covered per foot of section in one day. Therefore, in fields of average size, a three-section or 16½ foot harrow, behind a tractor, is easily capable of covering from 45 to 50 acres in a day. Small fields require more turning, which reduces the capacity, whereas large fields will permit of considerable increase over this figure.

Draft.—The draft of a peg-tooth harrow has been found to vary from 15 to 60 pounds per foot of width. Soil conditions and tooth angle are the chief factors. With the teeth set vertically the maximum pull was found to be 320 pounds for each section of 35 teeth, or 64 pounds for each foot of width. The average pull per foot of width for all tests made was found to be 28 pounds or 140 pounds per 5 foot section. A three-section harrow, working under extreme conditions, would require only 1000 pounds, approximately, which almost any small tractor can handle easily.

The Spring-Tooth Harrow

Sizes.—This implement, like the peg-tooth, is made up in sections with varying numbers of teeth or springs. These sections, however, usually are made in pairs and comprise two

units. These sizes refer to each section, and they have nine or ten teeth. The widths are about $2\frac{1}{2}$ feet per unit or about 5 feet per section. For tractor work ordinarily three or four sections with a total of about fifty teeth, covering about 15 or 20 feet, would be found a convenient size. Special attachments such as double pointed teeth or teeth for alfalfa or quack grass may be obtained.

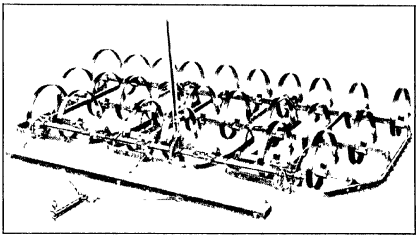


FIG. 53. A spring-tooth harrow with evener and clevis for tractor hitch.

Hitching.—The paragraph on the hitching of the peg-tooth harrow will apply equally well to the hitching of the spring-tooth harrow.

Field Operation.—Soil conditions will determine the use of the spring-tooth harrow on the farm. For localities that are stony or gravelly, the spring-tooth harrow has been found most satisfactory. The most decided advantage of tractor harrowing is due to the fact that sufficient power is usually available and, therefore, the teeth of the harrow may be set at the greatest angle needed. This makes for better pulverization, and for better work, because of the fact that greater penetration is possible, the lumps being broken to the depth of the tooth. The ends of the springs must be kept sharp. If renewable points are not used the springs may be sharpened like those of the peg-tooth type.

Capacity.—Since the spring-tooth harrow is approximately the same size as the peg-tooth, it follows that the capacity in

acres covered in a day will be the same. In general, under very favorable conditions, it may cover three and one-half to four acres per foot of width

The Draft of the spring-tooth harrow is somewhat greater than that of the peg-tooth. The maximum amount of pull recorded for any one condition was found to be 532 pounds per section of 17 teeth. This was a gravelly clay alfalfa soil For dry and very light sandy but stony soil, the draft has

FIG 51. A spring-tooth harrow with proper tractor hitch.

been found to be as low as 165 pounds per section This is about 55 pounds per foot of width. The average of all tests was found to be 148 pounds per 5 foot section, or 42.2 pounds per foot of width

THE DISC HARROW

Function.—The function of the disc harrow is that of the peg and spring-tooth harrows Its range of work is much greater, however, since it is a larger implement. It is differently constructed and works on a different principle Its work should always precede that of either of the other harrows. Tractor work requires a double disc. Its enormous capacity for work makes it almost an indispensable farm machine. It may be used before plowing or after, and, in many cases, it should be used in both, before and after.

Types and Sizes.—There are two types of discs procurable for harrows. One has been termed a "cut-away" or "spader"

disc and the other the "straight" disc. About 90 per cent of all harrows manufactured and sold are of the straight-edged disc type. Certain localities use the cut-away style,

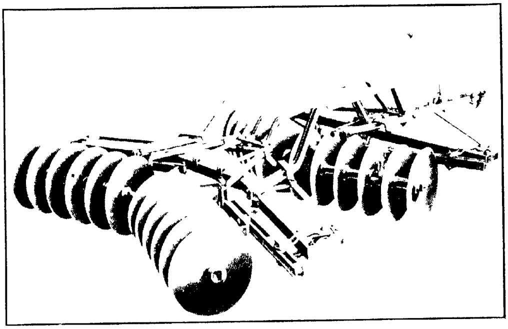


FIG. 55.—A double straight-disc tractor harrow.

but whether there is any advantage of one over the other has as yet not been determined. For tractor work practically all disc harrows are of the double disc style, which means that

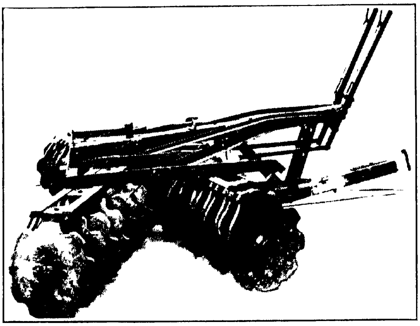


FIG. 56.—A double cut away disc tractor harrow.

they have an outward set and an inward set. Other than this difference in the shapes of the cutting edge of the discs, there is no great variation in the machines.

Disc harrow sizes are usually given in figures which represent their width. A six-foot disc harrow would cut a strip of land six feet wide This is just nominal and the actual size might be several inches either way. They may be procured to cut anywhere from six feet to ten or even twelve feet in width.

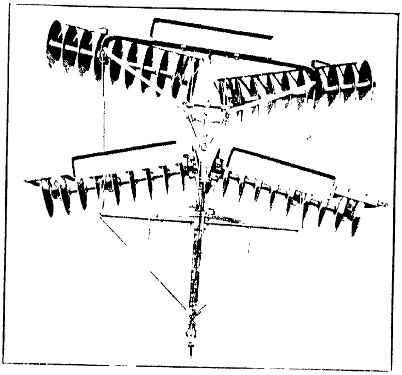


FIG 57 -Top view of double-disc tractor harrow

Hitching. — When a double-disc harrow is to be used with the tractor, it may be centrally hitched to the tractor draw bar. since the width usually exceeds the extreme width of the tractor wheels. The ordinary tractor tandem disc harrow is not provided with a forecarriage. It is usually hitched directly to the draw bar of the tractor Be sure that the hitch is of such a length that the tractor can turn freely without danger of bringing the drive wheels or the extension lugs into contact with any part of the harrow or its frame. If extension lugs come close, they should be removed or the hitch lengthened The tractor, therefore, must support the front end of the harrow. Cables or chains should never be used with this type of harrow. This is because the

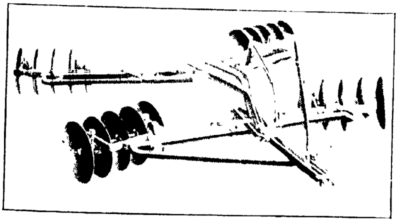


FIG. 58.—A double-disc tractor harrow for orchard work.

tractor is the steadying member for the harrow. In such cases the tractor performs the function of a forecarriage. If a forecarriage is to be used, a length of chain from 14 to 18 inches should be put between the harrow and the draw-bar of the tractor. This arrangement will allow the harrow freedom to operate properly. This is quite necessary and will probably apply more particularly where the farmer has a tandem horse harrow that he wishes to use with his tractor.

In hitching any harrow to a tractor with a high draw-bar, say about 18 or 20 inches from the ground, care should be used to see that this height does not have a bad effect on the harrow by tending to lift the forward gangs. If the tractor draw-bar can be adjusted, it is good practice to get it down to at least 12 or 14 inches or so from the ground. This will prove very satisfactory. Since discs are usually 18 inches in diameter, the nearer their center the power is applied, the easier and the better they will work. Two double-disc harrows may be hitched behind a large tractor, and in such cases a long evener or draw-bar permanently secured to the rear of the tractor will be found almost necessary. Such an arrangement will permit the hitching of the two disc harrows in their proper place to this long draw-bar. Its length should be about one foot more than the distance of the draw eyes of the two harrows when set alongside of each other as for field work. The long draw-bar should be of clean, straight-grained wood, say

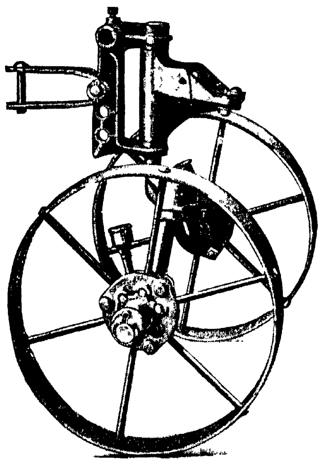


FIG. 59.—Forecarriage for disc harrow.

long leaf yellow pine or even ash, about 4″ x 6″. It should further be braced by the aid of a chain or cable running from its extreme ends to some convenient fastening place at the forward end of the tractor frame.

If the double-disc harrow is to be used behind the plow, then there must be an abundance of available power. Where farm lands are large the large plow gangs are most commonly used. To be an economic success, therefore, the disc harrow should cover just as much ground as the plow turned. In such event a hitch may be used which calls for center line hitches, and the peg-tooth harrow, or a roller, or even a plank harrow may be used to crush clods and lumps. When sufficient power and large lands are available, this plan makes for economical farm work.

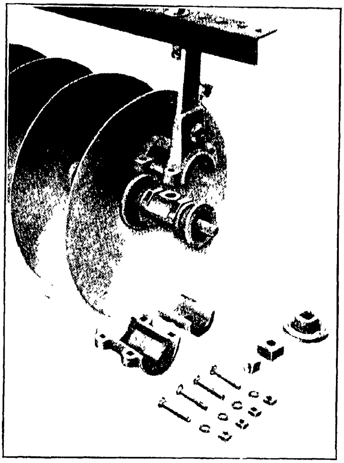


FIG. 60—A typical bearing for a disc harrow.

Field Operation.—The bearings, if of wood, will demand continued attention and may need renewing during the season. It is a good plan to fill the grease cups twice a day and, if they are sufficiently large, give them a full turn every hour during the day while at work. This also applies to bearings of chilled iron. If cutting commences, no amount of grease will stop it, and replacements are necessary. Therefore, lubrication should be given considerable attention.

Figure 61 shows a section of disc harrow. The center line represents the direction of travel when in use. "C" is the edge of the disc blade. When gangs are set straight, as indicated, the disc will cut a width from B to C, which is repre-

sented as "D." This, also, is the "dish" or "concavity" of the disc blade. When used for discing and set in this manner or straight, no real work is accomplished, and, in fact, in some light clay soils there is a tendency to pack, owing to the presence of the back side of the disc blade against the soil because of its weight. A disc should always be set at some angle to get penetration and good results. The distance "E" in the illustration is neutral, that is, undisturbed soil. The line "F," however, shows the extreme angle that may be had. It is a

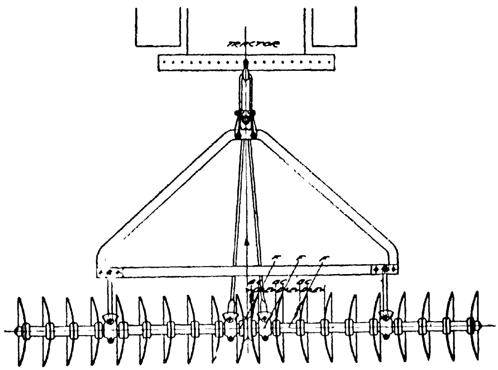


FIG. 61.—Section of disc harrow without any angle.

tangent to the curve of the disc blade "C." It is also the angle of the rolled or ground cutting edge. "B," as stated, is what is commonly termed the dish or concavity of the disc blade.

Figure 62 shows the disc set at a medium working angle. The direction of travel is again shown by "A." Here the disc will again cut from "B" to "C," or distance "D." There is now a smaller neutral strip. Consequently, nearly the entire width of the disc harrow is in actual operation, because the neutral strip is so reduced. The line "F" again shows the extreme angle that might be obtained. It will be seen that the disc is as yet far from being in direct line with the line of travel "A."

This same disc with the angle of the gangs further increased is also shown. (Figure 63.) It will be noticed that the angle has been changed so that the maximum cutting angle of the disc blade coincides with the direction of travel—that is, the cutting edge of each disc blade enters the soil straight. In such cases a slight lap is usually found; that is, the disc cuts a strip slightly wider than the space. Therefore, no neutral strip exists. This figure shows the maximum amount of angle

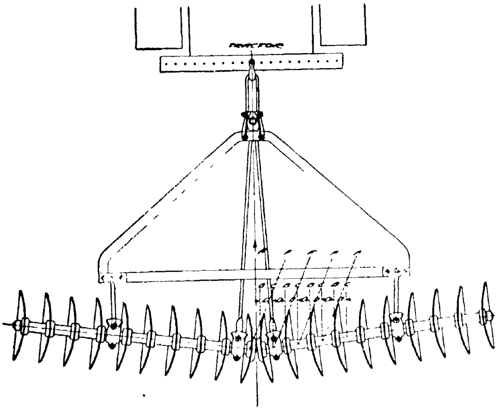


FIG 62—Section of disc harrow with slight angle

any disc should have. It allows the disc to do thorough work with the least expenditure of power. The tangent, or maximum angle, will in reality fall slightly below the center of the disc blade because of the depth at which it actually works. In fact, this cutting angle bears some relation to the depth.

A condition too often found in the field is shown in Fig. 64. The disc is angled too far. Its line "F," the tangent of the curved part of the blade, is set out of line of travel "A." In this case the disc skids along and does not do its work perfectly. It will not penetrate so deeply as if it were so set that the line "F" is in the direction of travel. Its skidding action

is exactly similar to the skidding of the front wheels of a tractor when trying to go forward with the front wheels

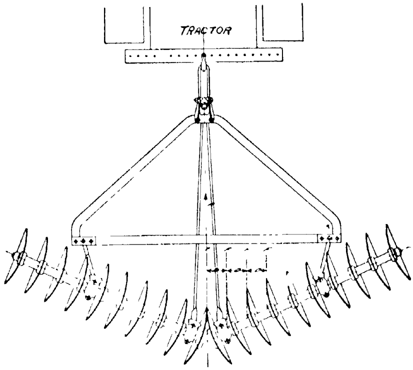


FIG. 63.—Disc harrow with proper angling to get maximum performance.

cramped too far over. Here the disc tends to come out; it rides shallow. It will draw hard because of the skidding or sliding

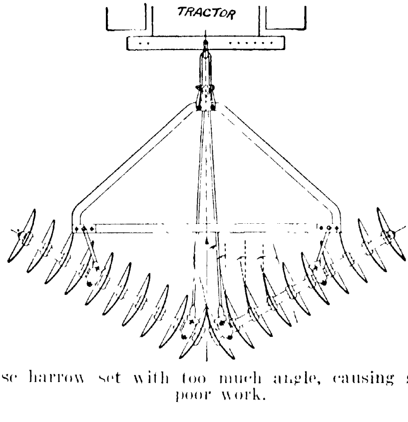


FIG. 64.—Disc harrow set with too much angle, causing skidding and poor work.

action of the blades in the soil. To keep it in the ground at all, weight must be added. Added weight increases draft, which

requires more power and consequently means greater expense because of the added fuel needed.

In our present power-farming era, the disc harrow has found a place as a valuable part of the farmer's equipment. It has already evolved into a special tool for use with the tractor. The present double-disc harrow is a valuable machine and needs good care to get good results

Capacity.—The capacity of disc harrows, according to the figures from the Department of Agriculture Bulletin No. 814,

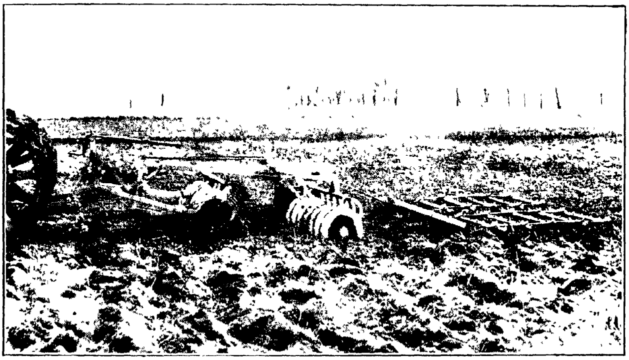


FIG. 65.—Disc harrow and peg-tooth used in combination

is about two acres a day for each foot of width of the implement on soft or plowed ground On good footing and with good horses, two and one quarter acres per foot of implement can be harrowed. This is based on a travel of about two miles an hour, which is the rate of travel of horses while at work.

A ten-foot disc harrow, used in connection with a tractor at the same rate of travel, should do from twenty to twenty-two and a half acres a day at this rate. This, of course, is double discing, while with the horses a single disc is generally used. Furthermore, there is the added work due to infrequency of stops and added rate of travel of tractor, which is a great increase. To disc twice in one operation with a tractor double-

disc harrow, means that planting can begin earlier, or at least more nearly at the correct time. A double-disc harrow used in connection with a tractor can easily do three acres per foot of width. In other words, a six-foot disc should cover eighteen acres a day, an eight-foot disc twenty-four acres a day, etc. This, it should be remembered, is double discing besides. In extreme conditions where the tractor is heavily overloaded, the figures given will be somewhat high, while if the tractor has sufficient available power and conditions are favorable, much more work may be done in a day. Under such favorable

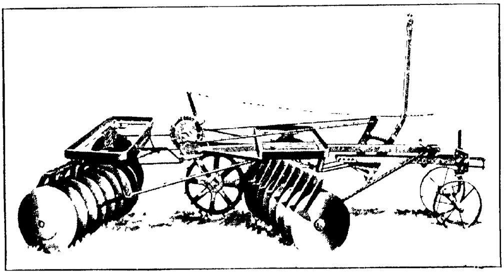


FIG 66 - Power angling, two-section disc harrow.

conditions as many as thirty-two acres of land have been double disced in a ten-hour day with an eight-foot double disc used in combination with the tractor.

Draft.—The matter of draft is a big one. So many factors influence this problem that no definite rule may be given that will hold good in all conditions The angle at which the discs are set is the greatest influence on the draft. The lubrication and condition of the bearings are another influence. Added weight, as shown above, due to too much angle to get penetration, means added draft Trying to work wet or very damp plowed ground causes increased draft also.

The draft of a double-disc harrow, therefore, varies with soil conditions, and condition of bearings used, working angle of discs and weight carried; and the sharpness of disc blades.

For a general statement, based on many field tests in various parts of the country, it is fair to say that 100 pounds per foot of width covered will be found to be an average. In spring-discing heavy clay land after plowing, the draft will run considerably above this — nearer 150 or 160 pounds per foot of width. Discing this same land, even though corn stubble, before plowing it will show a draft of between 100 and 120 pounds per foot covered. In sandy clay soils the draft will run from 70 to 90 pounds per foot of width, and yet, as previously explained, if weight is added to get penetration, owing to improper angling of discs or because of hard surface soil, it is possible to increase the draft from 30 to 50 per cent. Even in such cases the work is not done better than where the correct cutting angle is used.

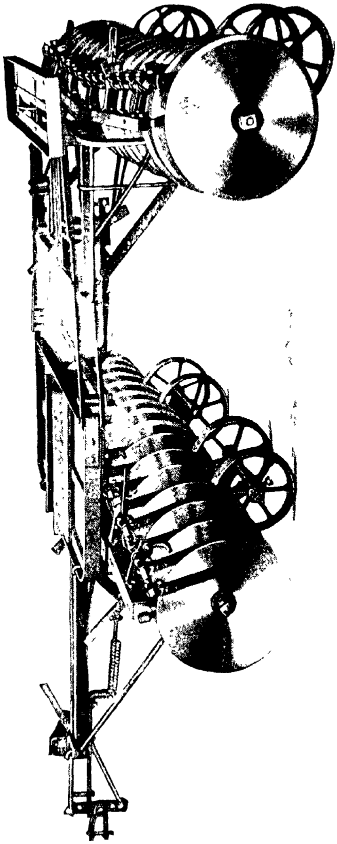


Fig. 67.—Double-disc harrow on transport wheels for moving over hard roads.

Discing before plowing means less draft than if the same piece is disced afterward In working on hills, of course, the amount of draft added is in proportion to the weight of the

outfit and the angle of the hill. It should be understood that the draft is much less when the discs work at a slight angle. The greater the angle up to maximum, the greater the power required to pull the disc. It should also be noted that to do good work means a full angled disc and this takes power. In fact, it is folly to reduce the angle in order to reduce the draft, because in such a case the quality of work is reduced. This should never be done, because it may have a tendency to reduce the crop yield. Thorough pulverization, with the least expense of power, is desirable. Sharp discs, whether cut out or straight-edged, are necessary to good work and have light draft.

Repairs.—Discs should always have a sharp cutting edge. Therefore, when the facilities are available for rolling the edges in a machine to sharpen them, this is much preferred. It hardens the edges while the rolling and sharpening is being done. Sharpening by grinding should always be done on the outside of the disc, and care taken not to get the discs so hot that the temper is drawn. A grindstone is preferable to an emery wheel for such work. Care should be exercised to get the angle alike all around. It is, therefore, good practice to rig up a fixture on which the disc blade may be set with the hole as a guide. Turn the disc blade as grinding proceeds. This procedure gives better results than any other method of doing this work. Be sure that a uniform cutting angle on the blade is maintained, and never remove any more by grinding than is absolutely necessary to sharpness and a good cutting edge.

CHAPTER III

LAND ROLLERS AND PULVERIZERS

Function.—To break up or cut the lumps left by the harrow and to press together the fine soil particles, a soil packer, or pulverizer, or roller, may be used. In some cases even planks arranged into a rectangle and secured together will do the work satisfactorily In some soils this means much work for this implement. In other soils, however, its use is unnecessary because they are pulverized so thoroughly by the use of the disc and peg or spring tooth harrow. The harrows get

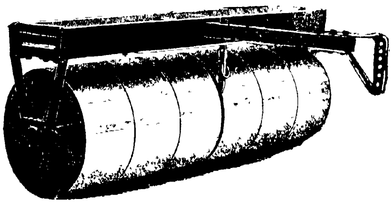


FIG. 68. A smooth-roller soil-pulverizer.

the soil mellow to a depth of from five to seven inches, whereas the pulverizers work only on the surface soil. Not alone should the lumps, clods, or chunks of certain soils be broken up finely and pulverized, but they should be packed firmly and thoroughly just at the surface. Most of this work is done by a double row of packing wheels set as closely as possible, with sharp edges tapering off to a flat. In some cases toothed wheels are used, either alone or in combination with sharp edged wheels, to get the same result. The rear gang cuts the ridges

made by the forward ones and leaves the soil in excellent condition for planting.

Types and Sizes.—There are several types of machines used for this work. The various types, of course, find favor in various localities where different soil conditions are found.

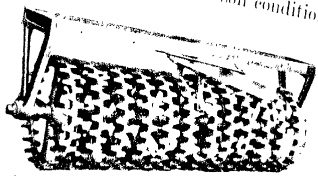


FIG. 69.—A clod crusher and pulverizer.

The most common types may be termed the *smooth land roller*, the *ridged roller*, and the *toothed roller*—the last is for rolling dry farming areas. A *plank packer* in some sections is very popular. The smooth roller is a single roller of from 20 to 24 inches in diameter. The ridged roller may again be subdivided into classes; those with all rolls alike, and those having alternate rolls, spiked or "star-wheeled," as they are often termed. These rollers are usually from 12 to 14 inches in

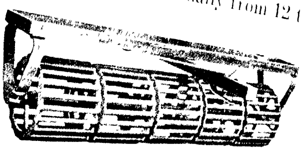


FIG. 70.—A bar-roller soil pulverizer.

diameter. Often two gangs are used so that the rear gang cuts the ridges of the front gangs. The rear gangs, too, are in most cases smaller in diameter.

For work such as pulverizing a spring wheat field of a clayey soil that has become lumpy or cracked, allowing

moisture to escape, this implement may be very successfully used. In this case it forms the top soil and seems to form a mulch far better in some soils than a peg-tooth harrow would and it would injure the plants far less

Sizes of land rollers are usually given in feet which represents the width of the roller A 6-foot machine would be one which rolls or pulverizes a strip 6 feet in width, a 7-foot machine would work a strip 7 feet wide.

Hitching.—For use with the tractor it, of course, follows that it can most successfully be used right behind the disc or other harrow In such a case it affords simple combination and ease of operation. In soil where the plows can do a good

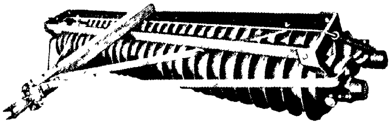


FIG 71.—Ridged soil-pulverizer with double set of rollers

thorough job of pulverization, the pulverizer can be used directly behind the plows This is, of course, very uncommon These pulverizers are, in such cases, secured by a cable to the draw-bar so it follows directly behind the tractor plow. A brace is often used on the plow gang, secured to the beams, to keep the pulverizer in place when turning on the headlands or when plowing around and around continually

These machines regularly have a single stub tongue which affords an easy and simple means of hitching direct to the tractor. Danger of side draft is entirely eliminated. When hitched behind a disc harrow, it helps to steady the same. In such cases, the pulverizer should be set reasonably close to this harrow. It will be found practical to hitch to part of the harrow frame itself. Never should the hitch be made on the gangs. Unless the tractor is very light, it is not practical to use this implement alone behind it If power is not

available to draw the pulverizer behind the disc harrow, it is best to dispense with this operation in combination with the tractor unless it is a small light tractor that will not pack too much. A good plan would be a narrow disc and pulverizer, at least one that could successfully be handled by the tractor. When hitching this pulverizer behind a disc, space for turning must be allowed.

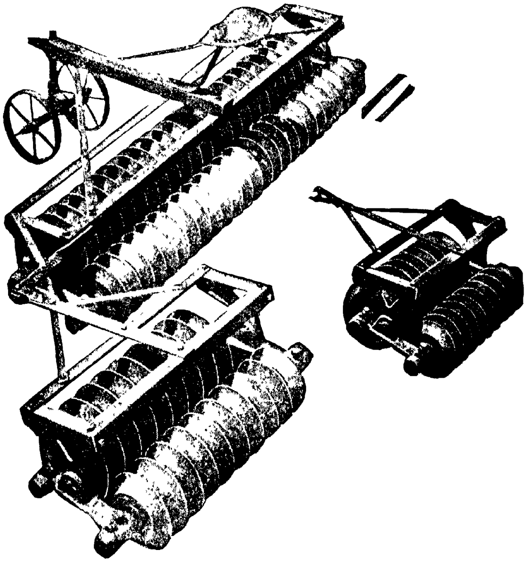


FIG. 72.—Ridged-roller soil pulverizer, with attachments for extreme width When used with fore carriage as shown chain should be used for tractor hitch.

Field Operation.—Of all implements this is one of the simplest to operate The only real trouble encountered is misalignment. This means that on double gang machines the rear gang of rollers does not exactly track with the forward gang. As said before, the rear rollers should cut the ridges made by the forward gang. Failure to do so is nearly always

due to the fact that the frame bolts have become loosened. This should be carefully watched. It is so simple that it is often neglected and unless these frame bolts are tight, and the front and rear rolls track properly, good work cannot be expected.

Extremely wide widths are not as good for tractor use—or any other use, for that matter—because they cannot accommodate themselves so easily to the unevenness of the ground as a machine in sections will. The cut shown is the most economical kind to use, and it should be chosen of a width to correspond with that which the disc harrow cuts if used in combination with this disc. The one long section and two short ones will do fine work in many localities. When used alone, any width that lends itself to local conditions is satisfactory.

When using certain types this implement on clay soils, or after a rain, or at any time when excessive moisture exists in the soil, it is important to see that the groove between the rollers does not fill up. Such clogging indicates that the ground is too wet to do a good job of pulverizing. It is best not to use the implement in such cases, because this "balls up" the soil and defeats the work of the implement. Often, only the spots on the field that are clay will tend to clog. The balance of the field will contain enough sand that this will not happen. If there are no scrapers on the machine, they should be added, else the work must be delayed until the ground is dry enough to be in no danger of such clogging. In localities where the soil is dry and hard it may be necessary to add weight to the machines to get proper results. When a smooth faced land roller is used, weight will in nearly all cases be necessary.

On the smaller machine with the sharp cutting edges, however, it will be found that the action is decidedly different. It should be remembered as well that the purpose of this implement is pulverization. Therefore, although the added weight will require more power, it will pay for itself by the

work it accomplishes in comparison with a light machine just touching the high spots. It should be a rule with the tractioneer and the farmers to do as much work and do it as well as possible without adding weights of any sort to any machine.

Proper care of pulverizers simply means keeping the bearings properly lubricated. Unless boxes are provided that are dust and oil tight, they should be cleaned out every other day to prevent excessive wear due to the grinding action of accumulated dust or grit

FIG. 73.—A ridged roller soil pulverizer hitched direct to tractor draw-bar

If a dust-tight case is used, oiling is necessary only once a week. A pipe plug instead of a grease cup affords means for that purpose. It is a good plan to remove the bearings once a season and thoroughly clean the parts with kerosene before replacing. All frame bolts should be kept tight to be sure that the rollers track properly and work efficiently.

Pulverizing ground around young plants in row crops may be done. Many pulverizers are made so that the end wheels may be removed and the rest of them separated to permit

working the soil around the plants set in rows. In some cases the center roller is split and may be removed

Capacity. When the pulverizing machine is used alone with a tractor, the load is very light, even for the smallest tractor It follows, therefore, that it is safe to run the tractor somewhat faster than for heavy duty work It is, consequently, safe to figure on three acres per foot for an average of width per machine. Theoretically, a little over 3½ acres could be done if the outfit were kept going for ten hours without any

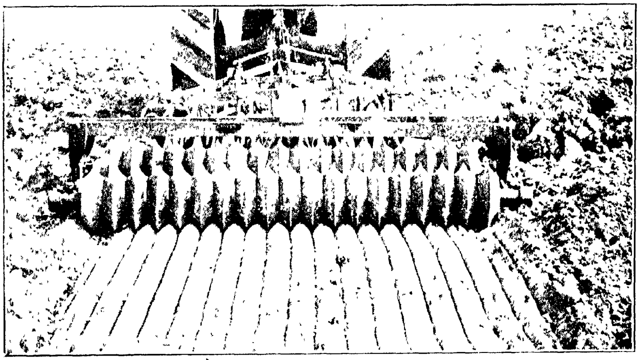


FIG 71 —Field scene showing work of a ridged roller pulverizer

stops. A 6-foot machine would cover 18 acres per day, a 10-foot thirty acres, or a 12-foot thirty-six acres per day. Under very favorable conditions four acres may be covered per foot of width.

Draft.—The drafts of these machines depend on the soils and conditions of moisture. It is often found advisable to load them with sand bags or large stones to get the hard sunbaked clods in some localities properly cut and pulverized To do this, of course, means increased draft. Tests made in the field show that the draft of the implements of the ridged-wheel type in two gangs varies from 20 pounds per foot of width to 85

pounds. The average soil in the wheat and corn belt shows a draft of 65 pounds per foot of width. Smooth-faced rollers will require from 20 to 70 pounds with an average of about 50 pounds per foot of width. When weighed down with bags of sand on each side, they have been found to require as much as 110 pounds per foot of width The average of all tests made reveals the fact that 65 pounds per foot of width represents a figure that may be used in general.

CHAPTER IV

DRILLS AND SEEDERS

Function.—The purpose of drills and seeders is to plant a stated quantity of grain or grass seed in the ground at a uniform depth and evenly distributed in rows of uniform spacing, the quantity and spacing depending on the soil, kind of seed planted, soil fertility, and climatic conditions. These machines also cover the grain so that it may find the most ideal condi-

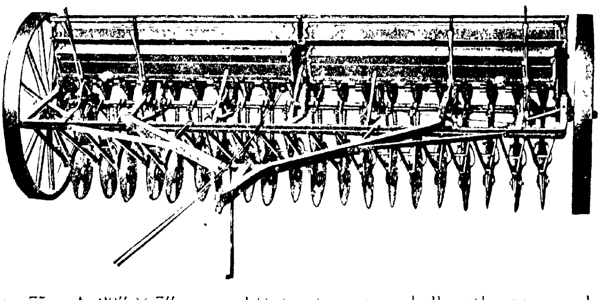


FIG. 75.—A 20″ × 7″ power-lift tractor grain drill with grass seed attachment.

tions for germination and growing. Fertilizers may be placed in the ground with the seed during this seeding process.

Types, Sizes and Rating.—With reference to furrow opening devices, grain drills are made in several types. The most common are known as disc, shoe, and hoe drills. The former are made with single or double discs. They are also made in combination and are called disc-shoe drills.

The hoe type has a hollow boot-like furrow opener through which the seed is conducted into a furrow cut by a point or

tooth riveted to the bottom of the boot. Some types of furrow openers used on certain soils make it necessary to cover the seed by dragging either chain links or other means attached behind the furrowing device.

Seeders are of two types In both types the seed is conducted through the feeds from the hopper or seed box, and falls upon scattering devices, and is broadcasted over the surface of the ground In one type, commonly called the *bar seeder*, teeth or points mounted on drag bars connected to the

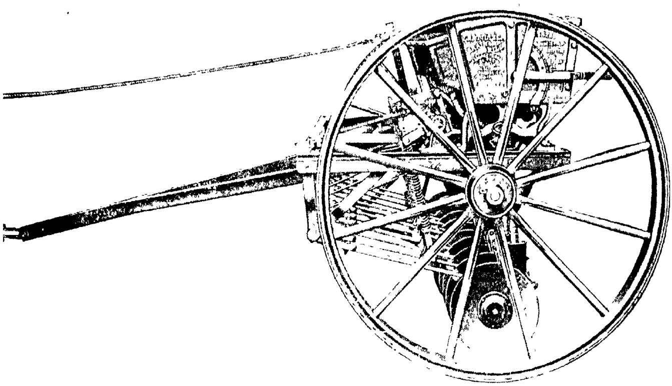


FIG. 76.—Side view of fertilizer grain-drill, with grass-seed attachment.

frame of the machine cover the broadcasted seed as the seeder passes on. The other type has no covering devices and simply broadcasts the seed upon the surface, after which it is necessary to cover it by another operation either with a disc or drag harrow.

The seed boxes on grain drills are of two distinct types, plain and fertilizer. Machines take these names, therefore, and are referred to as *fertilizer drills* or *plain drills*. In the former, two separate boxes with individual feeding devices are required, one for grain and the other for the fer-

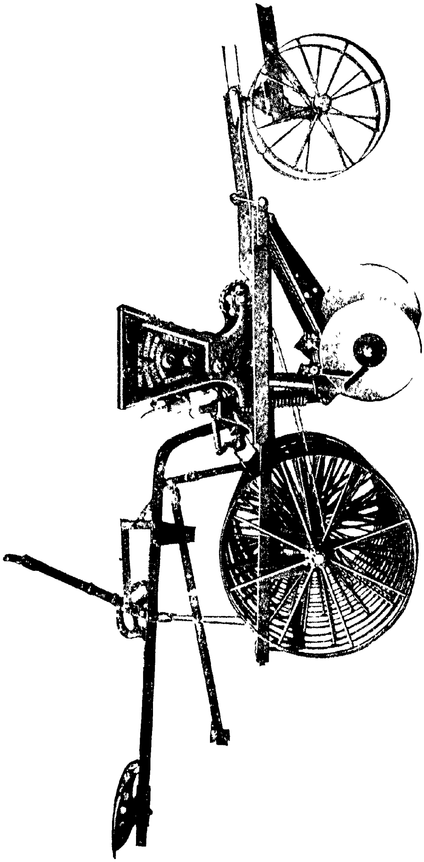


FIG. 77.—Press drill with closed delivery single discs. Discs staggered for clearance

tilizer. Both feed through a common feed tube into the soil. The single disc is the most common. There are only a very few territories in which this type of grain drill may not be successfully used With fertilizer attachments, making it a fertilizer drill, it is more common than the plain style. The choice of one or another of these types of machines depends on the soil. For sandy and stony land, or well prepared soil free from trash, the hoe drill has been found very satisfactory

The distance apart that the grain rows may be planted can be determined by the productivity of the soil. Drills will plant grain in rows 5, 6, 7, or 8 inches apart, and the amount of grain planted for any area can be varied by the adjustments provided on the machine. Seven inches is the most common distance between rows of small grain

Grain drills are rated by the number of outlet spouts and the distance between these spouts. For instance, an 18 x 7 grain drill has 18 openings which plant the seed in rows 7 inches apart This, therefore, means that a space 126 inches or ten feet and six inches wide is covered by this particular machine during its travel over the ground. In reality 133 inches (11 ft 1 inch) of farm land will be planted.

Another difference in grain drills relates to the feeding device and is termed "feed" It governs both the quantity and even distribution of the grain seeded. Practically all machines are today either the outside fluted or internal fluted wheel type for feeding grain to the tubes from which it is conveyed to the ground. These internal and external fluted rolls feed the seeds by means of the flutes. In the internal type, the speed is varied to suit the quantity of seed required. The external fluted rolls are moved horizontally to present a greater or smaller area of flutes to vary the amount of seed required. The selection of one or the other is a matter of personal choice, and some manufacturers make both types. In either case the grain is transferred from these fluted feed rolls into the tubes, from which it drops directly to the bottom of the furrow and is covered. The various drills also have at-

tachments for seeding grass seeds with grain. Different grains, even seeds of liberal sizes, such as peas and beans, may be planted in a very satisfactory manner by the aid of this machine by making some minor changes and adjustments in the feeding mechanism

A variety of attachments may be procured for these machines to enable farmers in different localities, with different soils, to do their work in the best possible way Drills for planting in light blowy soil are commonly termed "press drills." This term comes from the use of a series of wheels

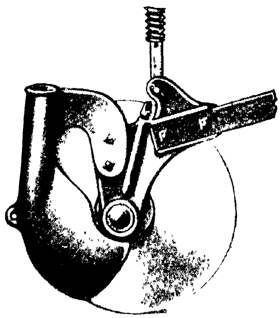


FIG 78 Concave side of open delivery disc furrow-opener.

that travel behind the furrow openers and press or firm the soil tightly around the seed to hold it in place until it has sprouted and stooled out. This pressure also tends to conserve the available moisture until maturity of the plant is insured.

Hitching.—Where the grain drill is hitched directly to the draw bar of the tractor, care should be taken to set the drill so that the depth levers are accessible to the operator from the platform or seat of the tractor. It often happens that owing to the different heights of tractor draw-bars, the wrong attaching irons are used with the drill. The front of the drill may then be set too low or too high, which may interfere with the proper operation of the machine. The operator can

easily observe whether this is correct or not, because the seed box should always set square or level.

In general, a single grain drill should always be hitched directly to the draw bar of the tractor; that is, no link or chain of any sort should be used unless provided with fore-carriage. Hitching a drill behind a tractor requires no special skill, since the tongue is located in the center of the machine, eliminating all side draft. Frequently, however, when two or more

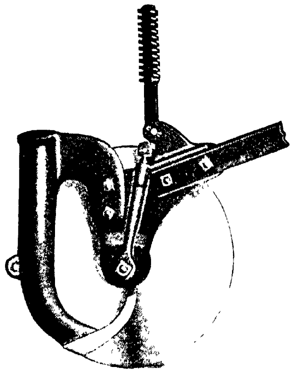
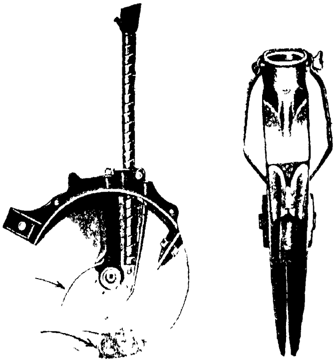


FIG. 79.—Concave side of closed-delivery disc furrow-opener.

drills are hitched to a tractor, it is well to use an evener of some sort. In such case it is always necessary to use a fore-carriage device to carry the load of the evener and the forward part of the grain drill. On large fields of uneven ground, this plan is desirable since it permits of better operation of the drills.

Since the load of pulling a drill is very light, it follows that two or more drills can be drawn—depending on the size of tractor used and the area which is to be seeded. Where small tractors are used, a single drill of considerable width can be most easily handled. Only a single hitch and single trip rope are required. This makes an ideal one-man outfit. Care

should be exercised by the operator to see that the drive wheels of the tractor will easily clear the frame of the drill when turning short



A B

FIG. 80. Double disc. A, Inside view; B, rear view.

Another very common combination is that of two 16 x 7 or 18 x 7 furrow drills behind the average size tractor. Here a

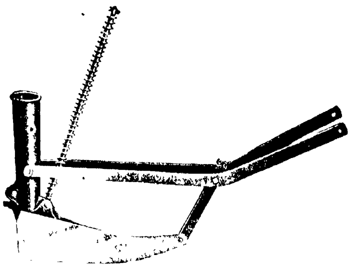


FIG. 81.—Shoe furrow opener for grain drill.

hitch should be made to have one drill travel slightly behind the other so that it may track properly. The object is, of course, to get all the ground covered with grain and not

leave a strip unseeded. The same holds true when a greater number of drills is used in combination with the tractor.

FIG. 82.—Hoe furrow-opener, with opening trip release.

The length of the long evener is determined by the size of the drills used. The center line of hitch should be located midway between the two tongues or in the center of whatever

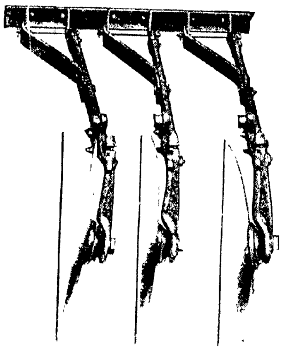


FIG. 83.—Single disc furrow-openers should be set with a slight angle as shown in center. Both outside discs are improperly set. Double discs are always set straight.

number may be used. When practicable, the drill may very well be narrower, and in this case used directly behind a har-

row. Such a combination will materially help to seed the grain in very thoroughly The pulverizer, or soil packer, may be used behind the drill if power is available and a most thorough job of discing, planting, and packing accomplished in this manner, particularly where work can be done on big areas. It is hardly advisable in some "winter wheat" localities, however, as in seeding winter wheat the rows should be left furrowed to counteract the tendency to winter killing by the freezing and thawing action of the soil.

The advisability of using this combination, of course, depends on the size of the fields that are available. If the fields are too small, it may be difficult to handle it successfully. Where large fields are available, areas from 150 to 250 acres or more, it will be found very satisfactory and practical. On such machines, where the operator rides directly on the grain drill, it is equally important to arrange the hitch so that the drill runs level. The hitching of machines of this type, however, is simpler because the tractor and the drill are usually made by the same company or else made to fit together correctly.

Field Operation.—Seeding with a tractor should never be attempted on wet or even very moist ground. One of the difficulties encountered by attempting to do so is that the weight of the tractor will no doubt be so noticeable that the drill discs will either not enter the ground at all, or they will plant so shallow as to interfere with the yield Soil that carries clay will only ball up and "puddle," as the farmer terms it.

In certain fine, sandy soils much trouble arises from the fact that fine grit gets into the disc bearings Where double discs are used, it becomes doubly aggravating to find the bearings worn out in a single season. A liberal quantity of light grease forced into the bearings at least once a day, until it leaks out at the side, will, in a measure, tend to work the dirt and grit out with the grease. The bearings should always be well lubricated, because it must be remembered that practically the entire weight of the machine and the grain to be planted is

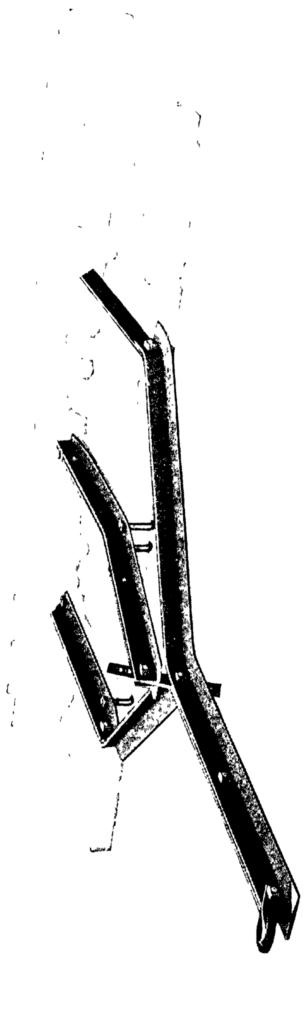


FIG. 84.—Tractor hitching-irons for single grain drill.

carried on the discs rather than on the wheels. It should be a part of the oiling program to oil the wheel and axle bearings at least as often as the disc bearings are oiled On those drills of the internal fluted kind, where the speed is varied to suit the quantity of grain planted, it is very important to keep the bearings of the change-speed gear drive well oiled The small vertical shaft carrying the pinion needs special care. The bearings of the shaft are sometimes provided with removable cast-iron bushings for easy replacement when they are worn If the bearings are well lubricated twice a day at least replacements will never be required

On those machines with the external fluted feed rollers, further adjustments may be found that will permit opening or

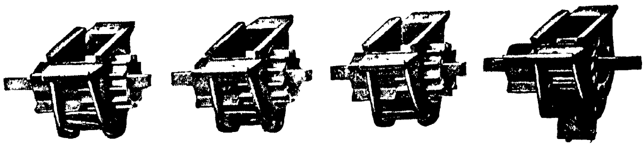


FIG. 85—External feed for grain drill

closing the outlet. For seeding small seeds this outlet may be closed up pretty well, but there is no danger of closing it entirely, for a stop usually prevents this For medium sized grain, such as large plump wheat, the medium setting will be found satisfactory. For larger seeds, such as peas or beans, it will be well to see that the opening is set at the maximum to be sure that seeding is not reduced at this point

On grain drills of the internal fluted feed two runs for the grain to enter will be found. One is usually numbered (No. 1) for small grains and the other (No. 2) for large grains. A reversible cover plate is provided for the side not in use and before placing seed in the hopper all plates should be turned alike When the cover No 1 shows, the small run is in use

Much care should be taken to get a uniform setting of the depth lever. Seeding should never be done when turning on

the headlands, in fact, it is always a good plan to seed in lands and in one direction, allowing the headlands for turning, as in plowing, then seeding the headlands at the finish. It is best to allow about twice the width of the drill for the headlands, and the last two lands on each side may be included in the final trip around the field in finishing the seeding.

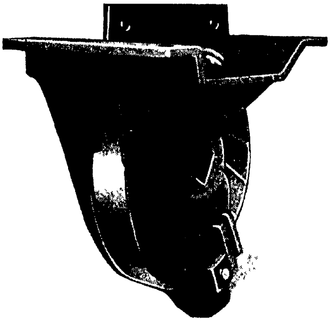


Fig. 86.—Internal double-run feed-cup and wheel. One side of cup for large seeds and the other for small seeds.

It is an excellent plan to have the bags of seed grain pretty well distributed over the headlands so that the seed box of the drill may be refilled at intervals. To run out of seed in the middle of a field, and upon replenishing not to know exactly where drilling ceased, is very aggravating. The operator should be very careful to keep watch of the outlet tubes. They become clogged at times and this difficulty is not revealed until the seeds have sprouted out of the ground. To prepare land areas with unplanted spaces is a waste of work. Great care should be taken that each feed is working at all times.

One essential to successful operation of a grain drill is the selection of the seed to be sown. It should, first of all, be clean and it should be selected and graded, because the results will be reflected in the harvest. Trash may clog the feeding mechanism so that too much care cannot be exercised to use clean grain.

To get good and correct action of a single disc machine, the disc must cut at the correct angle. This means that it should set at a slight angle, as shown in Fig 83. This angle is correctly provided in manufacture and if all bolts are properly

secured, and disc spindles are not worn, it will be exactly right. Double discs, of course, will work best when they set exactly vertical.

The scrapers should always be set close so they do their work satisfactorily. In seeding a very dry soil they do little or no good, so may be removed. If, however, the soil is at all damp, they will be found absolutely necessary to successful seeding of grain. On double discs, it is necessary to use outside and

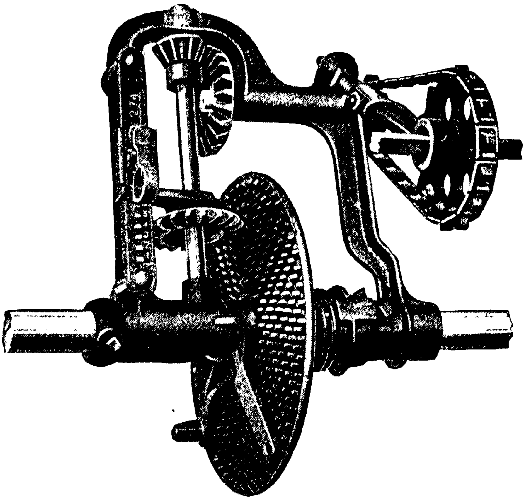


FIG. 87 – Speed change gears for internal feed type

inside scrapers. Spring pressure on the discs is important. On light soils pressures may be considerably less than on heavy soil. Hard clay lands require an adjustment of these pressure springs to insure penetration of discs. Planting is more difficult on hard soil and therefore needs special attention. Unless care is exercised, one field of heavy soil may be planted too shallow while a field of light soil, seeded with heavy pressure, may be planted too deep. Thus, in either case, there is danger of reducing the yield

On the under side of the feed box cover will be found explicit instructions relating to each particular make of drill. These should be carefully studied and diligently followed to get the most from the drill.

Capacity.—The capacity in acres covered in a given time is merely a question of width and the travel over the ground. A ten-foot grain drill—that is, a 20 x 6 machine—will have a capacity of about 16 acres per day at $2\frac{1}{4}$ miles per hour. This capacity allows for refilling the seed box from time to time and turning on headlands. It can be increased by using a faster tractor. For instance, at three miles per hour, it would

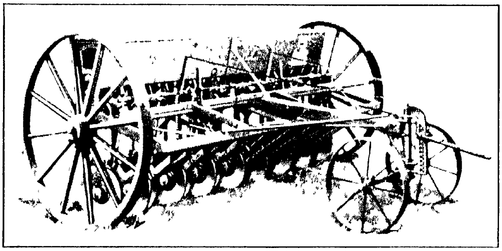


FIG. 88.—Grain drill, with fore-carriage.

be possible to sow 20 acres and at $3\frac{1}{2}$ miles, 25 acres. At three miles per hour a grain drill can easily cover two acres per foot of width in the average 10 hour day, accounting for the time spent in the field—even to spreading the sacks of seed on the headland and loading them into the seed box of the drill. Where fertilizers of various kinds are to be drilled in with the grain, additional time is required, and this reduces by about ten per cent the amount of work done.

The following table gives approximate capacities of various grain drills with different equipment and of different styles and types in average sized fields under average conditions. The figures represent the number of acres that may be seeded

per foot of width of machine, used with a tractor at a rate of three miles per hour:

Fertilizer Drill	$2\frac{3}{4}$ to 3	acres per day per foot of drill
Plain Drill	3 to $3\frac{1}{4}$	" " " " " " "

The amount of grain seeded has an influence on these figures, since seeding at the rate of two bushels per acre requires more

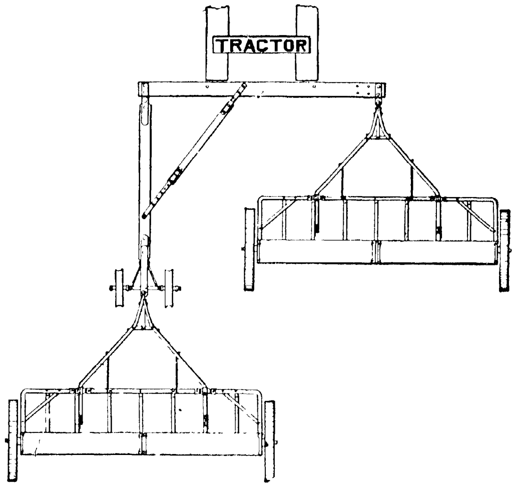


FIG. 89. Tractor hitch for two drills.

filling time than seeding at the rate of a bushel an acre. Plain drills will do slightly more, because no time is required to add fertilizer to the drill. The size of the fields has a decided influence on the time spent on turning on the headlands, so that in big fields slightly more work may be done in a day than in small fields.

Draft.—The power required to pull a single disc drill, a double disc drill, and a shoe or hoe drill, will vary with the depth of planting and the soil. Under general average con-

ditions, the fertilizer drill will require about 8 pounds per furrow opener per inch of depth. This varies as the seed box empties. On the average, a plain drill will require a draft of 6 pounds per furrow opener per inch of depth. It will naturally draw harder when the box is full than when it is nearly empty. The draft for seeding oats is less than that for seeding wheat, because the weight is only half as great. The

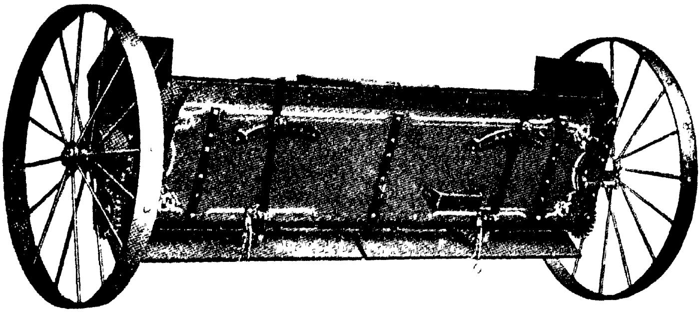


FIG. 90 Lime sower

depth at which planting is done influences the draft a great deal. While the figures of 6 and 8 pounds draft per furrow opener per inch of depth represent an average, it is advisable to consider other factors. Moisture in the soil affects the draft. Very heavy gumbo, if very damp, will increase the draft 50 per cent. A grade will increase the draft. Whether the bearings are well oiled or dry has an influence. The draft is increased about 10 per cent with 50 to 70 per cent increased rate of travel. Soil and moisture are, however, the greatest variables that affect the draft.

CHAPTER V

MOWING MACHINES

Function.—To cut grass for hay or other purposes is the function of a mower Since there are different kinds of hay to cut and since these grasses yield differently much is expected of this machine.

It should, first of all, cut clean; and, secondly, it should cut close to the ground It should have light draft and should run smoothly. The divider board should pull the swath over to leave a clear sharp line, showing the cutting edge of the standing grass. It should be convenient and easy to lift the sickle bar when turning and passing over obstructions, and to tilt it down or up to cut lodged or standing grass equally well.

Types, Sizes and Rating.—There is very little variation in the types of machines as a whole. However, there are differences in the methods of getting gear combinations to produce the proper crank and sickle speed required to cut the grass evenly. Each manufacturer nas his own device to meet this requirement, and all are about equally efficient. The crank shaft speed is based on the rate of travel. In other words, the sickle has just about a constant speed on all machines for every foot of advance As the rate of travel increases the sickle speed increases likewise New types, which may be termed tractor mowers and are really improved designs of the present conventional ones, may be purchased Some of these types are regular machines that may be hitched behind any tractor, while others, which may be termed mower attachments, may be attached to various makes of tractors These attachments usually consist of a sickle bar and driving mechanism. In such cases, power is taken directly from the tractor rather than

through independent drive or traction wheels, as on the regular mower.

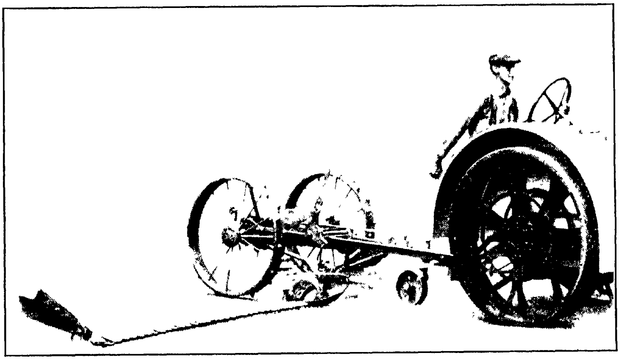


FIG 91 —Tractor mower, with power-lift mechanism.

Tractor mowers are built especially for use with tractors. Tractor power is not absolutely necessary, however, for they can be drawn by horses as well. The difference is largely one of improved construction In other words, making a mower that will stand up and give service under the severe demands due to increased rates of travel and long intervals of time without stoppages. The mower attachments may have sickle bar speeds in proportion to the travel of the tractor, or the sickle bar speed may be in proportion to the engine speed, irrespective of the

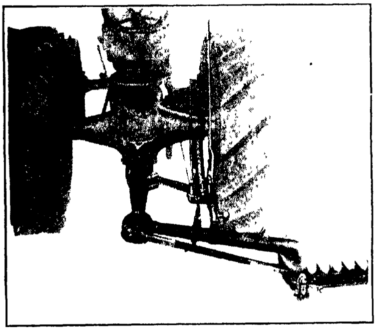


FIG. 92.—Mower attachment at rear of tractor

travel. In the latter case, it is possible to have the sickle travel very fast, while the tractor would be standing still or, at best, moving very slowly. Some of these attachments are placed in front of the tractor, while others are attached underneath and at the side, or in the rear, extending out sidewise. The choice of one or the other depends on the tractor in use.

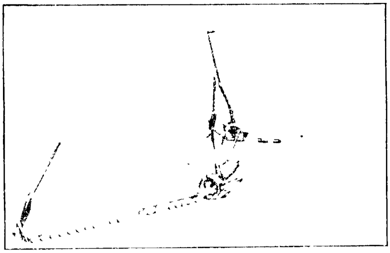


FIG. 93. Mower attachment at side of tractor.

Mowers are made in different sizes and rated by the length of sickle bar used. A five-foot mowing machine has a sickle bar five feet long. A six-foot machine has a sickle bar six feet long, etc. These vary in size from three to ten feet. The latter is the largest on the market and is found to be commercially practical. The small size is commonly used with garden tractors.

Hitching.—Hitching is a problem that demands some thought when these conventional machines are used in combination with the tractor. Mowers are machines with considerable side draft. Particularly is this true if two or more are to be used behind a tractor. In order to do good work special attachments in the way of hitches should be provided. A single 8- or 10-foot mower can easily be used in combination with the average tractor by employing the necessary hitching irons, together with a special stub pole. In every case, however, they should be hitched so that the tractor wheels travel with at least six inches clearance from the uncut grass.

It is well to remember that the mower should always be set well toward the side to allow sufficient room for the tractor wheels. On large tractors that are very wide it is not good practice to use a mower, because it has such light draft and

because to use such a small machine with a large tractor might not be economic field work. In no case should the mower hitch on the draw bar of the tractor be so high as to prevent the sickle bar from lying down flat on the ground. Then, too, an extremely high hitch may tend to lift on the mower enough to remove some weight and affect the traction which would cut down the sickle speed, because it is driven by the traction of the wheels on the ground.

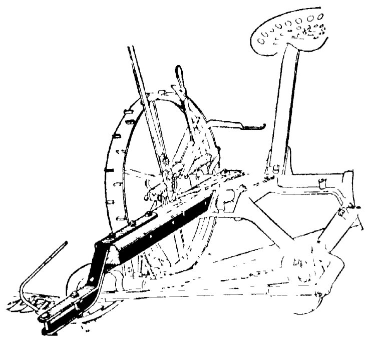


FIG. 94.—Conventional mower, showing clevis for use with a tractor

Securing a mower attachment to a tractor is a simple matter if the instructions which accompany the attachment are closely followed. Special tractor mowers, on which provisions are made to lift and lower the sickle bar by means of a trip rope operating a lifting device on the mower itself, are hitched with an ordinary clevis to the tractor draw bar. These machines usually have a truck or fore-carriage wheel making the mower really independent of the tractor so far as steadying it is concerned.

Field Operation.—When a regular mower is used in combination with the tractor, an additional man is usually called for to operate the mower On machines in which the tractor and mower become one unit, the tractor operator can conveniently run the entire outfit.

It becomes considerably more of a problem to use a mower with a conventional tractor than with horses, and special attention, therefore, is required As previously mentioned, some mower attachments are made to fit on tractors in such a way that they enable the operator of the tractor to attend to all the

adjustments needed on the mower without leaving his seat on the tractor. This arrangement makes a one-man outfit and has been found practicable.

The arrangement of levers on a regular mower so as to enable the tractor operator to attend to them is a considerable task. It should be borne in mind, that to get good results, the mower needs careful attention. This method, while it may be successful, is not so desirable, therefore, as having a man on the mower itself or using the special tractor mower or an attachment which takes its power from the tractor itself.

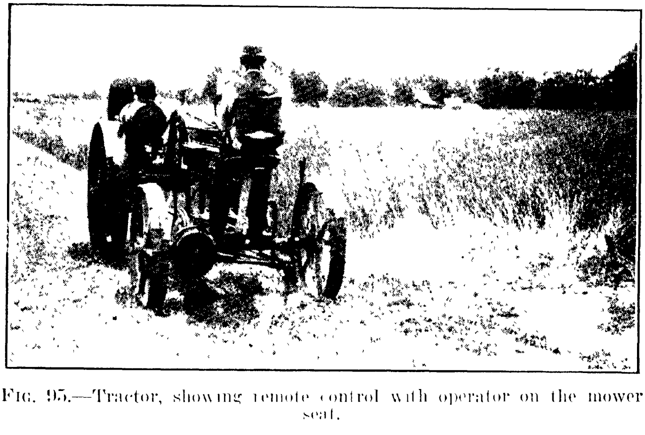


FIG. 95.—Tractor, showing remote control with operator on the mower seat.

The sickle speed of conventional mowers is approximately 3 complete strokes per foot of advance For this reason faster travel means faster sickle speed. Since the sickle is the important part of the machine, it demands a great deal of attention. Its alignment needs special watching The sickle bar should set exactly at right angles with the machine when it is running, which means that when standing idle, it should have what is termed "lead" The lead is usually one inch for each five feet of bar. A ten-foot bar, therefore, should be set with two inches of lead. When the machine is in operation

the work of the sickle, due to its travel in the grass, springs back enough so that with this setting it will be practically at right angles with the machine proper. To determine whether this is set right, a string, drawn very tight, may be run from the center of the wrist pin on the crank shaft directly over the center of the pitman itself, and out to the end of the bar, which will afford a straight line from which these measurements may be taken. Adjustments on various machines are possible, to get proper lead on the sickle bar. Each particular machine should be thoroughly understood so that the adjustments are properly made and continually maintained.

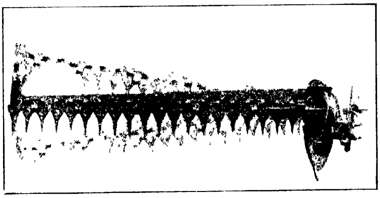


FIG. 96—Center shows properly aligned sickle bar. Shaded portions are misalignments, and are improper.

The guards on the sickle bar should also be very carefully set and kept in proper alignment If a broken one is replaced, care should be taken that the ledger plate is not too low or too high. Shims may be used if necessary, or the guard, being made of malleable iron, may be bent up or down with a hammer. The ledger plates should be examined also to make sure that they are sharp. If they are not sharp, they should be replaced, since it is not practical to attempt re-sharpening them, unless satisfactory facilities are available.

The wings on the guards guide the grass to the knife, and these need to be examined as well, to see that they do not bear down on the ledger plate. The guards also may be re-pointed if they become very dull and blunted.

The knife back should always be straight. It can best be examined by sighting down the bar

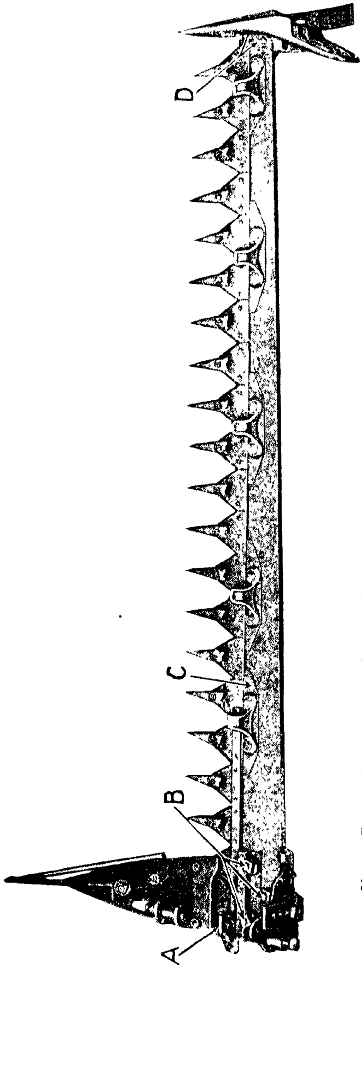


FIG. 97.—Sickle bar. A, Inner shoe location; B, Bar fastening; C, Wearing plate on bar; D, Outer shoe.

On some machines, wearing plates are provided which may be adjusted to take up the forward and back play of the sickle. A slight play should always be allowed to prevent danger of binding. A sixty-fourth of an inch is enough, but it should be the same all along the bar. It is good practice to have an extra sickle knife for each machine. This makes it possible for the operator to take this extra one along into the field, and replace the dull one, when it is necessary. This also enables the operator to grind them both in the evening or early in the morning.

It should be seen that the sickle knives register. By "registering" is meant that they travel an equal distance on either side of the center line of the guards. If the knives do not register, it may be necessary to lengthen the pitman rod or the drag bar, or whatever means are provided to accomplish this. Machines should be examined thoroughly to see how this can best be done. The pitman rod connection on the sickle bar should be carefully watched for proper adjustment. The same thing is true on the adjustment at the crank end of the pitman. If the joints here become so badly worn that they cannot be kept tight, replacements should be made immediately, otherwise a broken pitman will be the result.

At the outer end of the sickle bar, and on its lower side, is a part which is termed the *outside shoe*. This part is intended to carry the outer end of the sickle itself. It is usually adjustable for height, and should be carefully set to cut the hay as short as desired. On some machines a small wheel is used, and this wheel should be well oiled and so set that it has a lead away from the grass and toward the swath.

The *inner shoe*, located at the inner end of the sickle bar, has a purpose similar to that of the outside shoe: to support the inner end of the sickle. It is put to greater service and receives more wear, however. Provisions for replacement are made so that it may easily be kept in first-class condition and it also may be set at different heights. Both the inside and the

outside shoes should be so set that the bar cuts the hay at a uniform distance from the ground all along its length

The divider board and the swath stick should also be in first-class shape, since they, too, have an important function to perform. They should mark very clearly the line of the uncut hay as a guide to the tractor on the following round and to get the maximum amount cut at all times.

The bearings that need special attention are the wrist pin, or pitman pin bearings, and the lower end of the crank shaft. It is important that they be kept tight, and this can best be done by having them properly lubricated. If either of these

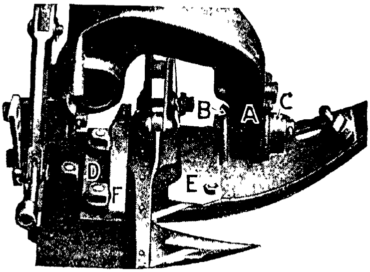


FIG. 98—Inner shoe, showing hinge pins and pitman connections.

bearings start to pound, immediate replacement of the worn parts by new bearings is best An extra wrist pin bearing may well be carried in the tool box of the mowing machine for just such emergencies, and an extra bushing for the lower end of the crank shaft, because when this bearing wears, only a new one will suffice.

Constant attention to these bearings is necessary to be absolutely sure that they have sufficient lubrication. It is a good plan to lay out a schedule for oiling and follow it diligently—say, for instance, oiling these particular parts every thirty minutes. This schedule applies particularly to the present conventional machine used with a tractor and not to the special high duty tractor mowers or special high duty mower attach-

ments. For tractor work more frequent oiling is needed, naturally, than for the slow horse-drawn speeds. Where anti-friction bearing equipment is used on machines, no trouble should occur. With such equipment the machines should easily run a week with one oiling. It is a good plan to keep oiling all the other bearings also at regular intervals of every day or so. Neglect in this instance is certain to cause trouble. For machines having enclosed transmission gears be sure that the gear cases have sufficient lubricant to oil the gears and bearings properly. Generally it is satisfactory to use steam engine oil or any good grade of automobile transmission grease for such work. The gear cases need be only partially filled, one-third to one-half full, because the gears when running carry this oil around, lubricating all moving parts.

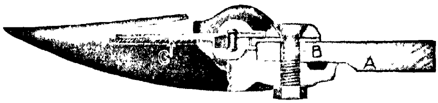


FIG. 99.—Section through sickle bar.

The ratchets in the drive wheels and the wheel hubs themselves, should be oiled daily It is also a good plan to oil the sickle bar frequently in fact, this part should always be well oiled with light machine oil every time the knife is changed.

Capacity.—The United States Department of Agriculture has done considerable work in making investigations to find out how much work is accomplished by the average mower in the hands of the farmer Their figures * reveal that on an average, a five-foot mower cuts 10.4 acres per day. The average six-foot mower cuts 11.9 acres per day. From this it may be seen that two acres per foot of length of sickle bar is a fairly good average on which to calculate capacity These data, of course, refer to mowers drawn by horses and the speeds at which they travel, which is from 2 to 2¼ miles per hour.

* Bulletin No. 814 U. S. Dept. of Agri., April 24, 1920.

Tractors will easily travel 50 per cent faster than horses which means a rate of travel of from 3 to 3⅜ miles per hour and that much more work done in a day. From the Federal figures given above, it was found that a 6-foot machine does fifteen per cent more work than a 5-foot machine, and a 10-foot machine will do correspondingly more. A special tractor mower with an 8-foot cutting bar, hitched to a conventional tractor, traveling at a rate of three miles an hour will be able to cut from twenty-five to thirty acres in a 10-hour day. This figure represents an entire day's work with a tractor and one man. It is not uncommon to find that a ten-foot mower, used in combination with the tractor, cuts thirty-five acres of hay per day of ten hours. In exceptional cases, as many as forty acres have been cut in ten hours with machines of this type and size drawn by tractor. Mower attachments for tractors, cutting from six to eight feet, are easily capable of cutting three acres per foot of sickle bar per day of ten hours.

One of the objections to mower attachments for tractors, often cited to discourage the use of tractor with the mower, is that the tractor wheels have a tendency to thrash out the heads or break the leaves loose from the hay, particularly when very dry clover is being cut. This objection may easily be overcome by cutting early in the ripening stage and allowing the hay to cure in windrows. The same objection can also be successfully removed by using a side delivery rake in combination with the mower or immediately afterward, cutting well matured hay of different kinds. Besides that, the divider board, if properly adjusted, will make a track for the drive wheel of the tractor so that this objection is overcome. In some cases the rake can be hitched to put the grass in windrows as soon as cut. The average tractor has enough power to do this readily. The question is merely one of getting the proper hitch. This makes it possible to run the tractor drive wheels on the stubble between the windrows. For such a combination, the rake should be hitched directly to the tractor draw-bar and not to the mower.

Draft.—The draft of mowers is a problem which varies with the grass that is being cut, the sharpness of the sickle, and the degree of lubrication.

In a series of tests, an eight-foot mower in first class condition, cutting clover and timothy hay on level land, showed a draft of from 450 to 525 pounds, with an average of 487 pounds. A ten-foot mower, cutting alfalfa in good condition and on level land, showed a draft of from 550 to 575 pounds, or an average of 566 pounds. These figures are at a rate of travel of about 2½ miles per hour. From them we find that

FIG. 100.—Tractor mower in field.

the average draft was 58.7 pounds per foot of sickle bar. The effect of dull knives is plainly shown in the following data: *

CONDITION OF SICKLE	DRAFT IN POUNDS
Knives in good condition...	455 to 478
Knives about 50% dull..	538 " 562
Knives very dull	560 " 622
Knives dull, guards bent and ledger plates rubbing	531 " 718

This shows that a mower with dull knives may require about 75 per cent more power than when in good condition.

Field tests have revealed that the draft is slightly decreased as the travel increases. This is only about 10 per cent, yet enough to show that faster travel accomplished two things.

* Tests made at Agricultural Engineering Department of the University of Wisconsin.

The mower does more work and does it with a minimum expense of power. This increase in speed is only about 50 per cent over a regular rate of travel of $2\frac{1}{4}$ miles per hour, which would mean a travel of slightly less than $3\frac{1}{2}$ miles an hour.

Repairs.*—The sickle is the part of a mower that does the work of cutting and, therefore, requires attention to keep it in good shape and the knives sharp. In the first place, the knife

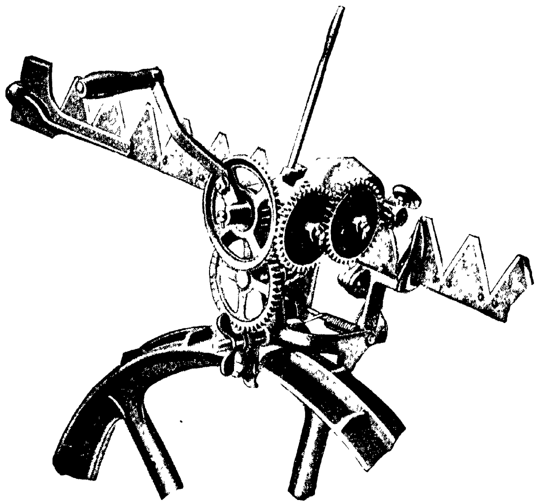


FIG. 101.—Sickle-knife grinder.

bar itself should be absolutely straight. Sighting along the edge will reveal whether or not this is the case; and if kinks are present, they should be removed by straightening on an anvil or straight iron. The clips that hold the knife bar should be hammered down so they just slightly clear without rubbing. If wearing plates are not adjustable they should be renewed if worn.

Grinding the knife sections is a job that should be very

* See Farmers' Bulletin 947, "Care and Repair of Farm Implements."

carefully done to be sure to keep the original angle of each section as nearly as possible. A special grinder for this purpose is a valuable device for doing this work well and doing it quite rapidly. When this angle cannot be maintained new sections should be purchased

When sections need replacing they should be removed from the bar by shearing the rivets rather than trying to punch them out. This latter method tends to enlarge the rivet hole so that a new rivet will not hold so well when the new section is put in place. Regular rivets purchased for this particular purpose should always be used for this work, and in no case should any sort of a substitute such as nails or screws be used.

Dull ledger plates may be removed and ground in a similar manner. The original angle should be maintained as nearly as possible, but new ones are preferable.

The guards should also be reground and pointed when they get dull and blunt.

CHAPTER VI

HAYING MACHINERY*

RAKES

Function.—Rakes are used primarily to rake the hay from rows, or "swaths," which have been left by the mower into more compact rows, which are termed *windrows*. These windrows are later raked up by the loaders and put on the wagon rack to be conveyed to the barn, or else they are handled by push rakes or sweeps for stacking in the field.

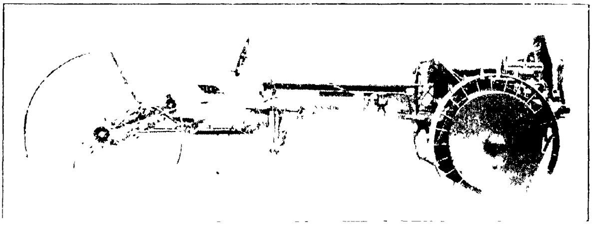


FIG. 102.—Dump rake, 10-foot, with tractor hitch.

Types, Sizes, and Rating.—There are several distinct types of rakes, such as the *spring tooth* rake, often termed *self-dump* rake, and the side-delivery rake, which may be subdivided again into two styles, the "cylinder style" and the "fork style." The *tedder*, while not exactly a rake, may be classed with them because in many cases rakes, particularly of the side delivery styles, will do the work of tedding hay. Tedders will, therefore, be considered here.

Practically all dump rakes vary in size from 8 to 12 feet in

* See Farmers' Bulletin 943, "Haymaking."

width, and they are rated in these sizes and termed 8-, 10-, or 12-foot machines. Side-delivery rakes have no rating for size other than the arbitrary numbers or names given to them by the manufacturers. Rarely does a manufacturer make more than one style or type and size. It is well, when purchasing, however, to know how wide a swath a side-delivery rake will handle. The most common size will rake a swath from 7 to 8 feet in width. Some manufacturers make side-delivery rakes for use only as such, while others may be purchased that can

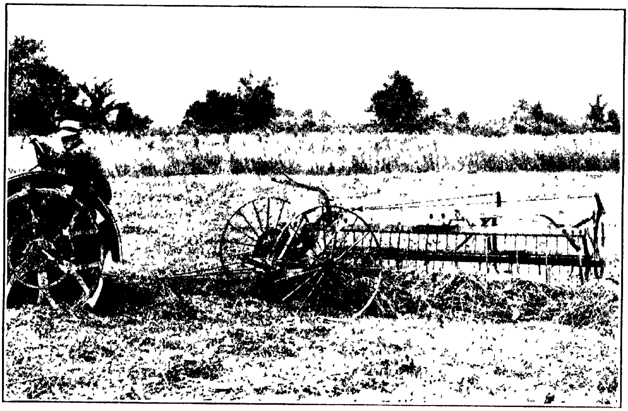


FIG. 103—Side-delivery rake, cylinder type.

be used as tedders. Such machines are usually termed *combination side-delivery rake and tedder.*

Hitching and Field Operation.—Since spring-tooth or dump rakes are usually rather wide, they should of course run very steadily, and to hitch them to the tractor usually calls for an "A" frame construction on the machine. Because the hay, in being raked, does not always come exactly in the center, one side of the rake frequently carries a heavy load and the machine tends to sway considerably so that a steady traveling machine calls for the "A" frame hitch device. Chains, or

light rods as braces, will not serve so well as a pole of wood or angle steel securely fastened to the rake as a unit. Care should be exercised to see that the machine is hitched far enough back of the tractor so that corners can be turned conveniently. Trouble is often caused by hitching so close that in turning the tractor wheels touch the machine. On such tractors as have extension cleats, too close hitching may even become a dangerous practice.

The conventional rake is so made that the operator uses his foot to press the rake teeth against the ground for clean

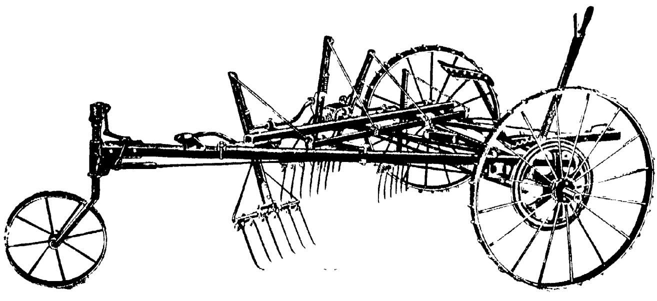


FIG. 101.—Fork-type side delivery rake

raking. If the man on the rake that is used behind a tractor is to be dispensed with, other means must be devised to secure his load or pressure on the teeth. A weight of 12 or 15 pounds hung on this foot lever will give the necessary pressure on the rake teeth. A trip rope secured to the hand-trip lever for dumping the rake is then necessary. Accordingly the dumping device must work against this weight used to keep the rake teeth down. The load should not be too heavy, lest the dumping device be broken or made difficult to operate. In any case the trip rope should be held tightly until the rake has dumped the hay, and then instantly released. It is important to see that the tripping lays the windrows straight and exactly in rows, to facilitate handling the hay

afterwards when the loader is used and guiding the tractor along straight rows.

The side-delivery rake of the cylinder type moves the hay from the swath into windrows, but leaves it in the direction of travel. This is exactly crosswise to the way the hay is left by the spring tooth or dump rake. The side delivery rake does not require tripping, but works continuously, carrying the hay over to one side and leaving it in a windrow in a loose and fluffy condition which facilitates drying and allows the sun and wind to cure it rapidly.

The fork type delivery rake accomplishes the same results, but instead of having a cylinder with spring teeth, it has forks set at about the same angle as a cylinder which rakes the hay

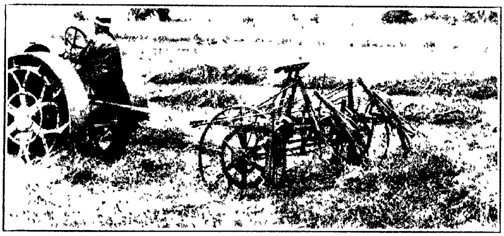


FIG. 105—Hay tedder

over toward one side and into the windrows. Combination machines of this sort usually are provided with means for reversing the direction of rotation of the cylinders, whereby they serve as very efficient tedders.

Side delivery rakes usually handle a swath from 7 to 8 feet in width.

The regular tedder has some of the characteristics of the fork type side delivery rake. They are rated according to the number of forks they have, which may vary from 4 to 8 forks; and they will handle a width from 5 feet to 9 feet. Their purpose is to handle the hay after it has been cut, particularly if

rained upon, turn it over and bring the bottom part to the top so that it may be dried out in the sun and wind in the quickest manner possible. A tedder should always be used after hay in the swath or windrows has been rained on. The combination side delivery rake may be used as a tedder, since the action of its cylinder and forks, when reversed, is very much like that of a tedder and accomplishes the same purpose.

It should be remembered that the gears and chains transmit the power from the wheels to the raking devices, and that the shafts upon which the gears and sprockets are mounted should

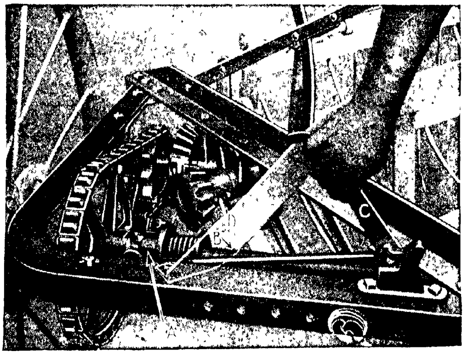


FIG. 106.—Gear shift, to change cylinder hayrake for use as a tedder.

be well oiled. They should always be well secured in their bearings so all gears may run well with each other. On those machines using the forks mounted on cranks, it is necessary to see that the fork boxes on the cranks receive special care in the way of lubricant. Where grease cups are used on the cranks, they should be turned down a trifle every hour or two to secure longer wear and better performance of the machine as a whole.

With machines of the fork type, the speed of the tractor should never exceed $2\frac{1}{2}$ miles an hour and even less is desirable to insure long life and good service from the tedder.

The wheels should not be neglected and it is very important that they be lubricated at least before starting out in the morning and at noon. The caster wheels which are used in some of the machines should also be greased at least once a day, since they carry a part of the load. The vertical spindles on the caster should be oiled daily. In all these

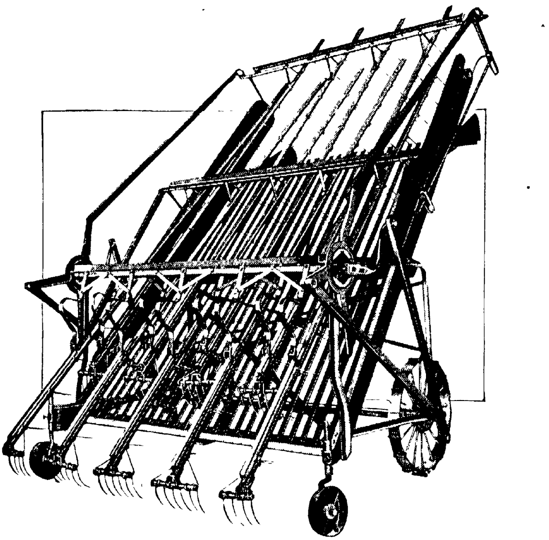


FIG. 107—Hay loader, fork-type.

machines, pawls or ratchets are used in the wheels as a driving means and to permit turning corners in either direction. These, too, should also be oiled regularly. A little attention given them in the morning and at noon will insure longer life and satisfactory operation. They are often neglected because they are unseen and perhaps not thought about, yet their improper operation often ties up the entire machine.

The gears should be well greased occasionally and sprocket

chains, when used, should be oiled once in a while. Chain drives should be properly set, so that they are neither tight enough to bend the shaft and cause unnecessary bearing loads, nor so loose that they tend to climb the teeth of the sprocket and jump off, which might cause a breakage.

All frame bolts should be kept securely fastened to keep the machine in proper alignment.

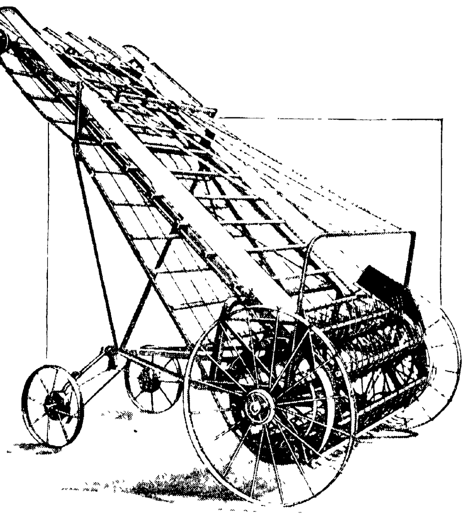


FIG. 108.—Hay loader, cylinder type.

The adjustment of these three types of machines to have them rake clean is a matter of experience.

It is not necessary to have the teeth of the rakes rub so hard on the ground that they dig up the plants. They need only touch lightly, and by their action they will rake clean. The more carefully this adjustment is made, the cleaner the raking will be and the easier for the loaders that follow in the next operation of field work. These spring rake teeth must always be kept securely bolted in place. Loose bolts allow

them to slip around, and frequently in this manner they are broken, which means poor raking. It is well to go over all the rake spring teeth before starting in the morning and at noon, to see that the bolts are tight. It is particularly important when the machine is new to see that the springs are tightened twice a day until they really find their places.

In the handling of the machines in the field, it is good policy to drive the tractor straight, since the loader is to go over the field next, and to make loading convenient rows should be straight. If the loading is to be done with two loaders, this is more important than ever. Then especially the rows should be parallel, so that these two loaders will work to their full capacity at all times.

Capacity.—An average figure of from 3 to 3½ acres per foot of width may be used to get the capacity of any type or style of hay rake. If the land is reasonably level and free from stumps, stones, and obstructions, it may even be safe to figure on four acres per foot of width. In such cases an 8-foot rake should, on an average, have a capacity of 32 acres per day.

Draft.—These machines have very light draft. An ordinary 8- or 10-foot size dump hay rake will require from 150 to 250 pounds pull. If the ground is very uneven and the spring teeth hang on the high spots, the draft will be affected. In general, however, 225 pounds may be used as an average.

Side delivery rakes of either type require slightly more power, and tests show a draw-bar pull of from 250 to 350 pounds. In a heavy field of alfalfa, the power requirements will be slightly more. In no case has a draw bar pull, on level land, been in excess of 420 pounds for a single machine of this sort in good condition. On an average 320 pounds will represent the draft of side delivery rakes.

Loaders

Function.—Loaders are machines which gather the hay from the windrows as left by the hay rakes and elevate it on a hayrack, on which it is hauled to the mows where it is to be

stored. Frequently, instead of storing hay in the mow, it is gathered from the windrows by push rakes or sweep rakes, and afterward handled by a stacker and lifted to stacks or ricks in the field.

Types and Sizes.—Hay loaders are made in two types, one the *cylinder* type and the other the *fork* type. The latter is sometimes termed a "gearless" type. The same principle as that described in the side delivery rakes is involved in these

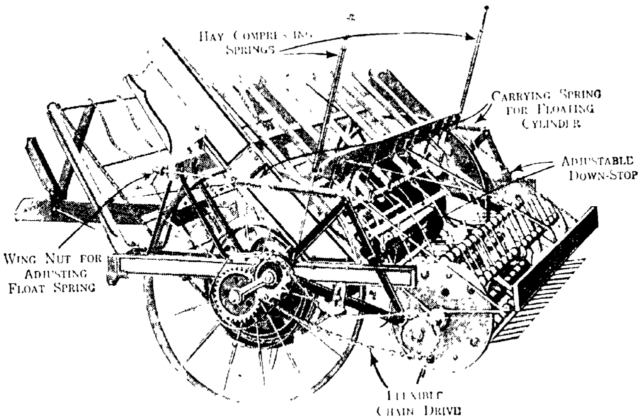


Fig. 109. Re-raking cylinder.

loading machines. In one case a series of small spring steel teeth or forks are fastened to the cylinder, by which the hay is gathered and elevated by means of an endless rake to the top of the machine and delivered to the hay rack bed on the wagon. In the other case the spring steel rake teeth are secured to long wooden forks which have a rotary motion at the lower end and a reciprocating motion above, conveying the hay to the top of the load and delivering it to the hayrack bed of the wagon. On some of the cylinder machines a re-raking cylinder may be used in combination with regular fork

cylinder to gather up loose ends and deliver them to the large cylinder or main cylinder which carries it up to the top and delivers it in the usual manner.

Sizes of loaders are nearly uniform in width. Two general widths, the 6-foot and the 8-foot, may be had. They represent approximately the hayrack width, which is about 84 inches. No real standard governs this figure, yet it is very close to what has been found practical to load, move about on the highways, and get into the average barn door and gate. The height of some loaders can be changed a little, but even this is nearly the same on all and ranges from 9 to 10 feet.

Hitching and Field Operation.—Operating a loader is not a difficult task. The most essential thing to their successful performance is to maintain a uniform speed or rate of travel. Hay cannot be loaded at breakneck speeds if a good thorough job of raking is to be done at the same time. To gather all the hay clean from the ground is the first consideration. To do the job hurriedly and leave a large percentage of hay on the ground unraked and unloaded is not good practice.

The first essential to good loading and clean raking is the proper adjustment of the vertical hitch between the tongue of the loader and the hayrack or wagon bed, because wagon beds vary in height from the ground Improper adjustment of this hitch may cause a rake to do a good clean job of raking and loading in one case with one wagon, and a poor job with another. On loaders having a fore-carriage, the hitch may be permanently fixed for good clean raking, regardless of wagon height.

If all the loaders—where more than one is being used—and all wagon beds are alike, it is merely a problem of hitching uniformly to get good results. This is a part of haying that is important and should be looked after carefully. When different wagons and loaders are used, it is a good plan to get a field setting worked out and just chalk down on the rear of the rack the number of turns of the winch crank that should be made to get the best setting. If one type of loader with different

wagons is used, the number of turns may again be marked on the rear of the rack. These details may all seem trifles, yet if rapid action and satisfactory results are to be secured, they will prove their usefulness. It is also logical to get all the hay available; and, besides, there is the fact that it will be unnecessary to re-rake the field.

When two loaders are used behind the tractor, which is the best arrangement, the loaders should be alike. The hay racks as well should be as nearly alike as possible. The loads will then be about equal and each man on the load will have about

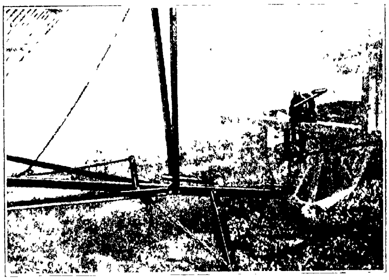


FIG 110—Hay loader hitching device showing winch for leveling loader

an equal amount of work to do, because both racks will be loaded in the same time.

Two wagons with hay loaders can easily be hitched to the tractor. It is important to get a hitch long enough to permit of easy turning without danger of injuring either the wagons or loaders. Turning corners will to some extent always be necessary, and it may be dangerous if the hitch is made too short. Uninterrupted performance is essential. This requires correct working parts on the loaders, which depends, first of all, on proper lubrication—sufficient to insure easy draft and the proper workings of all parts. On the cylinder loaders it means oiling the cylinder boxes regularly. The cylinder boxes have the hardest work, and need special atten-

tion. Since these elevating devices or rakes pass over a pulley or wheel at the upper end, it follows that these small revolving parts must not be neglected. Located as they are, pretty well above the ground, there is a tendency to neglect them. On some machines the shaft—usually a very small one made of gas pipe—is used, and in such cases, too, oiling is very essential.

All sprocket chains should be looked after carefully. 'A loose chain crowds and causes damage and delays by breaking. A tight chain causes unnecessary bearing friction, which may

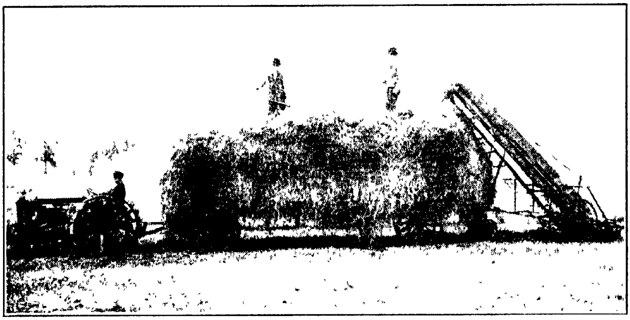


FIG. 111.—Hay loader, cylinder-type, in field use

wear out a box completely in a short time. Gears, too, should be greased occasionally to get the best results. The wheels of loaders should not be overlooked. Oiling them every half day is a required part of the work On some machines small caster wheels, or fore-carriage wheels, are used, and they need attention in the way of lubrication. All the bearings there are only a few—should be oiled at least every morning and at noon before starting out. The fork boxes on this type of machine need care and frequent lubrication. They should be kept tight, for if permitted to loosen they pound, and it takes only a little of this pounding to ruin them rapidly. The spring teeth on any type of rake need careful watching. They not

only become loose, but sometimes they break. One that has been lost or broken should be replaced immediately, otherwise the machine will not do its work well Eccentrics in gearless loaders need special attention in the matter of lubrication. It is poor policy to think that just because the loader is a simple machine it can run indefinitely without care Like any machine, its performance will be in direct proportion to the care it gets.

Capacity.—The capacity of a loader depends on the rate of travel and the width of the swath it handles Ordinarily much time is lost waiting for wagons, but if enough wagons are available, it is easily possible to rake 15 acres of hay a day in the average sized field and on level land. The rate of travel would then be about $2\frac{1}{4}$ miles an hour At 3 miles an hour, possible with tractor work, as many as 20 acres could be raked in a day with a single loader Of course, it would be possible to speed up and do more, but slow speeds, say up to 3 miles an hour, are permissible Speeds in excess of that figure should not be used when raking and loading hay. Under favorable conditions 3 acres per foot of width is easily accomplished.

Draft.—The draft of loaders is influenced by the type of loader, the degree of lubrication, the yield of hay, and the general adjustments of the raking teeth. An 8-foot cylinder loader in good working order on level land and raking clover hay very close will show a draft of from 475 to 530 pounds. The peak loads will run to 725 pounds. An 8-foot machine similar to the above, but with the addition of a re-raking cylinder, will show from 150 to 250 pounds additional. If the re-raking cylinder is set very close, the total draft may run up to 1000 pounds An 8-foot forked type loader in good condition on a level field will show from 430 to 470 pounds draft. The peak loads will run to 750 pounds. These figures of draft include the wagon also These draft tests were made loading from $\frac{1}{4}$ to $\frac{3}{4}$ of the total load to get averages. The peak loads were found under these conditions.

STACKERS *

Function.—These machines stack the hay and take it either from the swath by the aid of a push or sweep rake, or directly from the load to a rack or rick. Where hay is to be loaded in a barn, unloading devices are necessary. When used for stacking in the field, however, regular hay stackers are more commonly used. Even combined rakes and stackers may be used.

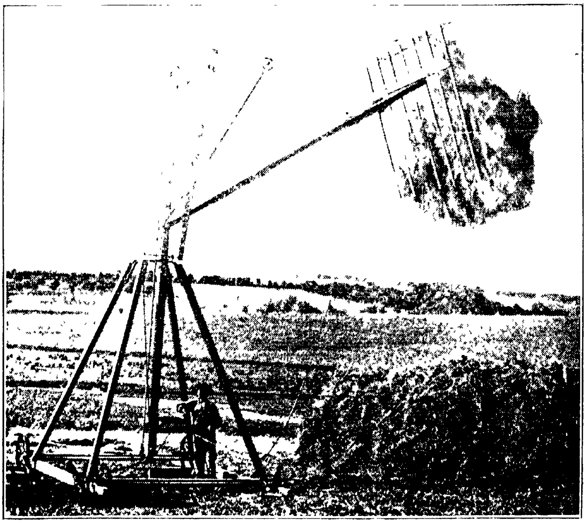


FIG. 112.—Swinging hay-stacker.

Types.—Two distinct types for the two different methods mentioned above are used. One we may term the *Gathering Type*, for use with the sweep and push rakes, and the other the *Stacking Type*, to be used with either the cable unloading device or the *swivel* elevating type. Where hay is the predominating crop, and where it is usually baled as soon as possible,

* See Farmers' Bulletin 1009, "Hay Stackers."

outdoor stacking is more common. In such cases mows are rarely available to hold the quantity of hay put up. Climatic conditions, too, sometimes afford a very good reason for stacking outdoors. Where hay is used for home feed, it is customary to stack in barn mows; the regular unloading devices are, therefore, most common. Tractors for use with stacking devices may be used with unloading devices for unloading hay from a hayrack. They may even be used for hauling the wagonloads of hay from the field to the unloading devices, when this is done in preference to using push rakes.

Field Operation.—The use of the tractor with hay loading and unloading machinery at best must be done with caution. Such machinery is usually not especially built for tractor use, and the question is largely one of getting a rigging to lend itself to the use of unloaders, push rakes, and sweep rakes with the tractor. A push rake lends itself better than a sweep rake. It must be securely fastened to the front of the tractor. In some localities it has been fastened to the rear, and with the tractor running backward; but it is difficult. In fields of considerable size it has been found more practical to place it in front of the tractor. Since the load is very light, usually that of two horses, only a small tractor should be used for such work. In some localities motor cultivators are used for this work, and, because of their construction, they seem to lend themselves very well for handling hay from the windrows by push rakes. From the push rakes the hay is delivered to the elevators. Various types and kinds of rakes are used, depending on the farmer's individual choice in the matter. In any event, the hay is to be lifted or pushed to the top of the rick. Where the farmer chooses to use a regular unloading device on a cable, fastened between two poles over the rick, and to unload directly from the sweep or push rake by means of a fork, such usage is practicable.

Since these machines are comparatively simple, very little need be said about their care and operation. About the only

parts that need special attention in lubricating them are the small wheels which travel on the ground and the shearer pulleys. They should be watched, and oiled frequently. On the swivel type stacker, some attention must be given to the swivel, both the upper and lower ends, to be sure that it is not cutting and wearing out unnecessarily fast. Swivel stackers should also be securely anchored, and care taken that

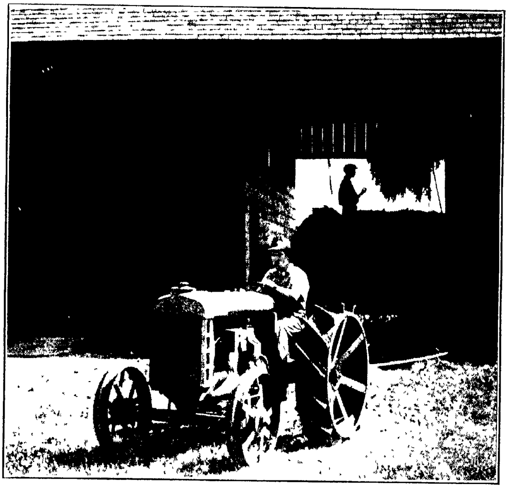


FIG. 113.—Unloading hay into a mow.

there is no danger of their tipping; otherwise much damage will be done. The same is true when staking down the poles and securing the cables and also when building ricks in the field for this device.

UNLOADERS *

Function.—This machine unloads hay from the loads into the mows or hay barn. It is also used for field stacking where the cable device is used. Hay forks, sometimes two, are fastened to a rope leading from the hay unloader to a power

* See Farmers' Bulletin 838, "Harvesting Hay with a Sweep Rake."

device, usually located outside the barn. Instead of a fork, slings are sometimes used to carry the hay up and dump it in the mow.

Types.—Practically all unloaders are of one common type: a device consisting of sheave pulleys and track rollers, running on either a cable track at the very top of a hay mow, usually extending out over the edge of the door so that hay may be loaded directly from the wagon, and at the same time being

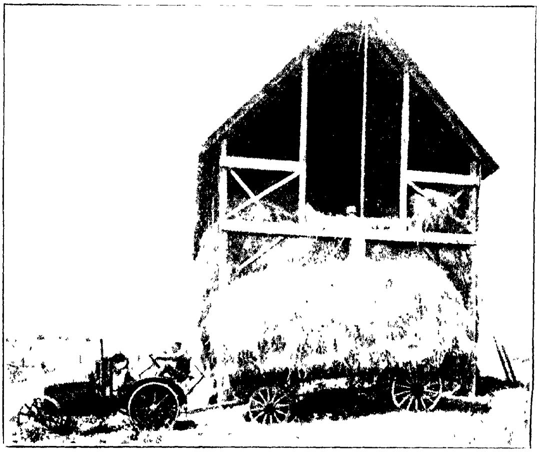


FIG. 111 Hauling hay loads.

delivered on the trolley track or cable to the farthest end of the barn.

Operation.—Since machines mentioned in this chapter are so nearly similar, it follows that the operation for all are practically alike Power may be furnished by the tractor. Sometimes a hoisting device, belted to the tractor, is used. This makes a good rig In such cases it is unnecessary for the tractor to travel back and forth over the ground to unload the hay.

The principal concern in the operation of these unloaders is to see that the sheave pulleys and track rollers are well lubricated. Located as they are, pretty much out of the way, it is a rather difficult task to reach them, but they should be lubricated at least twice a day to insure positive performance. To have them fail from improper lubrication means rapid wear, with consequent faulty performance. It is not uncommon for them to go off the track because they have cut on account of lack of lubrication. On all unloaders a snatch block is usually used, and this needs attention, particularly lubrication. The snatch block is usually located where it can be conveniently oiled. Those just above the fork or sling can be conveniently oiled because they travel from the load up and are very often close to the ground If the sheave wheels stick and do not turn, it is apparent that the rope must slide on the wheel itself, and thus wear out in a comparatively short time. A splice in the rope is difficult to make and is at best unsatisfactory; therefore special attention should be paid to lubricating the various sheaves through which the hoist ropes pass. Since unloading is just as important as any other operation in haying, although not so complicated with regard to machinery, the farmer should recognize that the unloading machine requires lubrication in order to get the hay into the mow with the least possible expense of power or trouble from breakage.

Draft.—The draft on an ordinary hay unloader depends on the weight of the hay, which in turn is determined by the kind of hay that is being handled Ordinarily it has been found that from 300 to 500 pounds draft is required to carry a single forkful up into a mow. If two forks are used, the draft will run slightly under double these figures because the load is slightly less than twice as much. With a sling it is possible to get a bigger load, and frequently as much as 500 or 650 pounds are handled. The general average for a single hay fork, however, will be close to 400 pounds per load.

CHAPTER VII

GRAIN BINDERS

Function.—As its name indicates, the purpose of a grain binder is to cut grain and bind it into bundles. It should therefore cut standing grain of all kinds and heights or grain that is lodged and down, and tie a band of twine about it, making the bundle. This machine should enable the operator to change the length which the straw is cut and the size of the bundle, and it should cut all small grains with equal ease and with the least expenditure of power and labor. It should tie the bands with a degree of certainty that will permit handling the bundles in shocking, stacking, and loading on wagons, and unloading to the threshing machine

Types, Sizes and Rating.—Grain binders are made in practically only one style or type, which is nearly general throughout the country Most of the binders manufactured are of the conventional style of type. Each manufacturer employs slight mechanical differences, yet all accomplish the same thing, and in nearly a like manner.

Attachments of various kinds, such as for loading headed grain or for handling bundles in a quantity for a shock, or regular shocking attachment, are made as parts to go with the grain binder. Separate engines, even, are used as attachments to drive the binding mechanism when conditions are such that the drive or bull wheel is unable to furnish the necessary power because of soil conditions and lack of traction. Some tractor binders have been developed, and are on the market, which differ from the conventional machine in that the power required to cut and bind is taken directly from the tractor to which it is hitched, instead of through the bull wheel, as in

the case of the regular machine. The purpose is to make the work of this binder a function of the tractor engine speed instead of a function of the bull or drive-wheel of the binder itself.

Unlike the plow and some other implements which have been redesigned entirely to meet tractor work—supplanting the horse—the binder has in all but a few cases remained

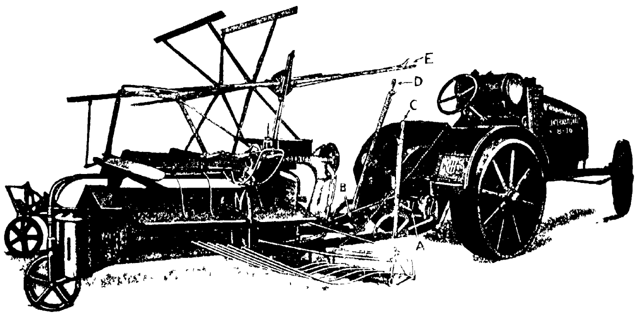


FIG. 115.—Tractor binder receiving its power from tractor engine instead of through bull wheel.

practically unchanged In only these few instances have binders been developed and marketed primarily as tractor binders, and even then they are usually made as 8- or 10-foot machines. In some cases the tractor and binder outfit permit of the operators riding on the binder and at the same time running the tractor from this same location, making a one-man outfit. The increased rate of travel of the tractor over the speed of horses necessitates greater reliability in the binder. The fact that a tractor, unlike the horse, does not have the sense of easing off when obstructions are encountered, but just goes right along, too often injures a light binder very seriously. Therefore, we have special tractor binders, built sturdier and for use with tractors.

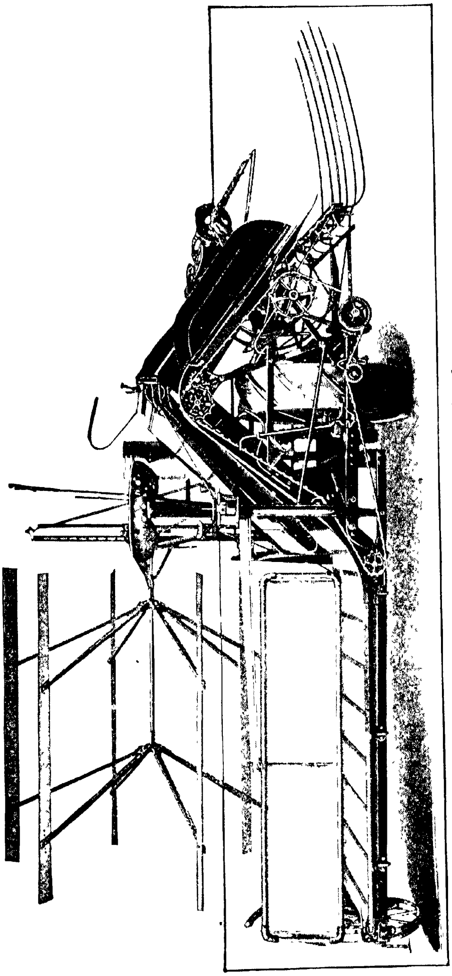


FIG. 116.—Conventional binder.

The sizes of these machines vary from 6 to 10 feet, which means that they will cut a swath 6, 7, 8, or 10 feet wide. The only general difference in these machines is in the cutting sickle or platform length. These machines are therefore rated as 6-foot, 8-foot, or 10-foot binders.

Setting-up.—The work of setting up the binders usually falls to the lot of the dealer who sells these machines to the farmer. Since practically all binders are shipped "knocked down," it becomes a part of the implement dealer's work to set them up correctly, ready for delivery to the farmer. Direc-

FIG. 117.—Tractor binder in one unit combination with operator of both machines on the seat of the binder itself.

tions for doing this work accompany the machine, and are very clear and explicit. In spite of them, however, dealers too often neglect to do properly the work of setting up. Bolts are not tightened as they should be and parts are not always assembled exactly as the manufacturer instructed. The result often causes trouble to the farmer when he gets into the field. One of the most lamentable things in this respect is the fact that lubrication is rarely done thoroughly. This should be insisted upon by the purchaser before taking delivery of the machine. It is not because the farmer who purchases it cannot or does not know how to oil it properly, but

because he insists that the machine be properly oiled before he takes the binder to his farm, that the dealer will be more careful to look after this oiling The farmer's insistence on this point will in a measure make the dealer responsible for his part of this work. Before starting out from a dealer's store, the transport wheels and the fore-carriage wheels should be greased thoroughly, and after starting should be watched carefully, because neglected axles and wheels may be ruined in a trip of three or four miles into the country

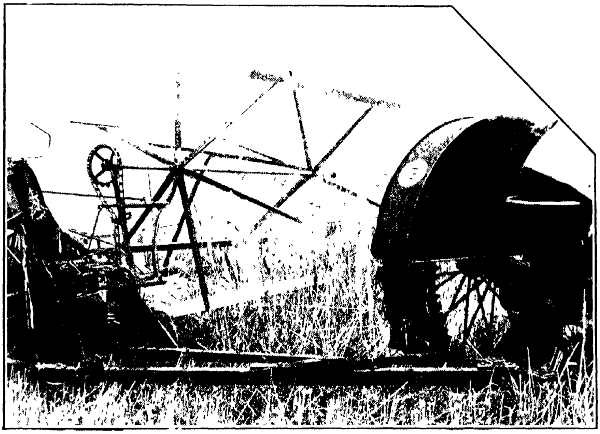


FIG. 118—Binder hitch, turning a square corner in field

Hitching.—The farmer should be sure that a hitch is made properly in order that the work may be finished as quickly and as thoroughly as possible Since there is a critical time for cutting grain, to get reliability in this power-farming unit means that everything should work smoothly and well for economy's sake.

When purchasing a new binder to be used with the tractor, it will be well to make this matter clear to the dealer. Then the binder can be set up complete with the necessary binder

hitching attachments for this method of work. The modern power farming dealers will have such attachments in stock. In fact, it is almost impossible to do good work in the field unless a special binder hitch is used in combination with the tractor. It should be remembered to make the hitch so that the platform may be adjusted to suit the ground and grain. It is necessary to change the hitch more or less throughout the day to get all the grain and frequently it should be raised to avoid striking obstructions.

The hitching of two or more binders behind the tractor is a difficult task and should not be done unless the fields in

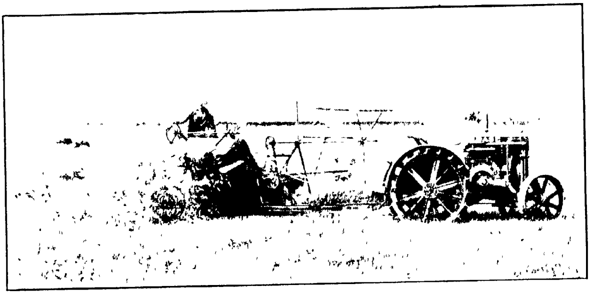


FIG. 119.—Conventional binder and tractor, with remote control.

which the harvest is to take place are very large. It is a very difficult thing to turn with an outfit like this. On hilly land this combination of two or more binders will be a problem. It should also be borne in mind that in such a case it is the best plan to have one man ride on each binder in order to get the maximum service from the machine. Binders for use on tractors that make one unit of the outfit, and provide for the tractioneer's riding on the binder and from his seat operating both, and since this unit has only one way in which to couple, that hitch makes the attachment complete.

If the tractor operator has conventional type tractor, it may be that attachments can be procured which will enable him

to ride the binder and yet control the speed and gear-shift and steering of the tractor from this position. Attachments like this are commonly termed "remote-control" attachments. Often they may be used with other machines, and even on wagons, etc. If, however, the tractor operator expects to handle the binder from the tractor platform or seat of this conventional tractor, he will find his task a big one. To try to steer the tractor and handle the binder properly in such a case is a job that requires a great deal of attention and skill. Unless the unit is close coupled and the operator skilful, it is better to put a man on the binder whose duty it will be to attend to this machine.

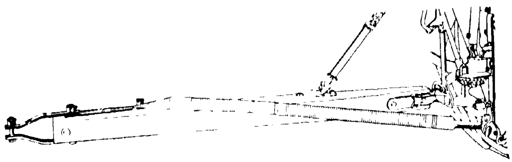


FIG. 120.—Hitch bar for conventional binder.

It should be remembered that the binder must always be kept well up and into the grain to get the most work done in the shortest possible time. If down grain is found, it will require a good operator to handle the platform and reel to get such grain cut.

The hitching, therefore, is an important job, and deserves much attention. The hitch should be set to enable the tractor operator to guide the tractor so that it travels at least a foot or so from the standing grain. Therefore the binder should be kept well into the grain and this may be easily accomplished if the man on the binder is continually alert. This is an important part of the function of the hitch. Then, too, this hitching device should permit of easy turning, particularly at the corners so that they may be cut square. It is not advisable to make this binder hitch on the farm, since they are on the

market, and may be purchased from the dealer at a nominal figure. Not that the farmer cannot do this, but because regular attachments have proven a very satisfactory and an economic part of the power farmers' equipment.

Field Operation.—Before taking the binder into the field, it is a good plan to lubricate thoroughly every single rubbing surface or bearing on the machine again. (See chapter on lubrication.) It is also a good plan to drive around on bare ground or through a pasture for an hour or two beforehand to be sure that the tractor and binder are properly hitched

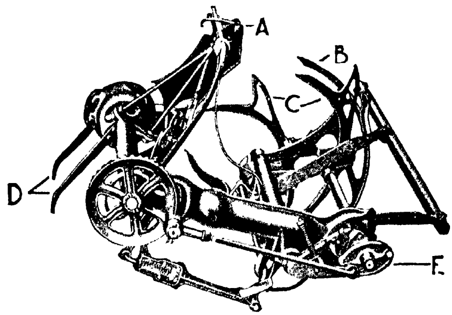


Fig. 121.—Binding mechanism on regular grain-binder.

to make the combination that is desired. Then, too, it eases up the bearings, and works the oil into them better and allows the oil to reach the places that should be lubricated. A liberal amount of good lubricant should be used every little while on all bearings during this limbering-up process.

After this, it would be satisfactory to go into the field. It should be remembered that a slow speed will, in the beginning, accomplish more than a rapid gait which is apt to cause trouble, because, as said before, it is to be remembered that the conventional binder of today, that is used with the tractor, is, with a few exceptions, only a horse machine and was designed to work at a slow speed which is about two miles an hour. If

the power farmer is fortunate enough to have a special tractor binder of a wide width, increased speed will do no harm. A travel of three, three and one-half or slightly more miles an hour may easily be maintained if ground and grain conditions will warrant this.

As said above, binders, as a whole, are of the horse drawn type so far as construction is concerned. Since most power farmers have had experience with them, it follows that the care and operation in the field is the same. One of the most important facts is that the conventional binder, therefore, is the limiting factor in the rate of travel, and even though it is possible to run the tractor three or three and one-half miles an hour, it should not be done The binders will not stand up and perform if this is done. This is important and must be followed very closely It is possible to wear out a new binder completely in two or three days if operated at such fast speeds The factor of reliability is of utmost importance in getting the grain harvested at the proper time and by the shortest and quickest methods which is the aim of all good farmers. To get this factor into play means constant attention to the lubrication of the present binder. To neglect this, means danger of delay which may be brought about by breakage or improper functioning of relative parts due to wear. Before starting out in the morning and also at noon, the whole machine should be gone over very thoroughly Not a single place should be neglected. Besides that, it will be found good practice to stop and oil the canvas roller bearings and packer crank and other important parts between times It should be remembered that even with horses this was done very often, at least once an hour. Of course, the horses were resting, and while it seemed that this was the only reason for oiling the binder, it has been found that it was even better for the binder. In fact, if the farmer expects the best out of this combination, it is highly desirable to oil the binder every two hours at least. This will take lots of time, but will pay in the long run.

What has been said on the subject in the paragraph on mowers, applying to the sickle bar and cutting mechanism, applies equally well to the cutting mechanism of the binder. Since, however, cutting grain is considerably easier, due to the fact that it does not grow as thick as the grass which the mower cuts, the speed of the sickle bar is about one-half as great. Wear and tear is, therefore, correspondingly less. On the platform and leading from it are the canvases which convey the cut grain to the tying mechanism of the binder. It is highly important that these canvas raddles, or aprons as they

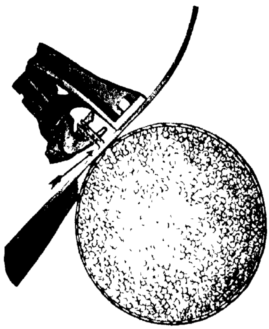


FIG. 122.—Knotting device drawing twine around bundle.

are commonly termed, travel square. Frequently the frame is sprung and more frequently the canvas is not buckled evenly. In either case, broken slats and unnecessary wear on the bearings, canvas, and slats is the result The canvas apron should be tight enough so it will run and do the work for which it was intended. They must run at the proper speed too. Slippage hinders the work of this machine and this should be carefully watched. To square up the platform or the frame for the elevating canvases, it is best to use light sticks—yard sticks will do—and measure diagonally; that is, from one corner to the opposite corner. (Fig. 129.) These

distances should be equal. If not, the frame is out of square and should be squared up.

The buckles on the canvases should always lead in the direction of travel Broken slats should never be used When leaving the machine for the night, it is always a good plan to unbuckle the canvas on the platform and upper and lower elevators. On some machines it is possible to release the tension on the canvas aprons by simply moving a lever at each

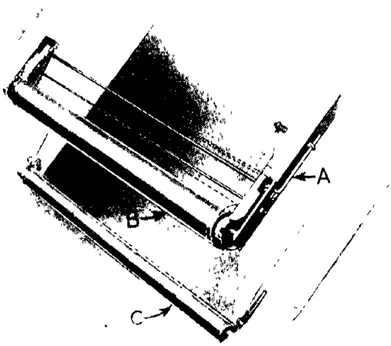


Fig. 123.—Canvas rollers, showing lever for releasing canvas tension

bearing position on one end These should be reset when beginning work with the binder which will again establish the proper tension. The moisture that gathers during the night materially effects the canvas and it shrinks. This, in many cases, makes the canvas so tight that bearings are worn out in twenty minutes upon starting the next morning with this condition existing, or the draft may be increased so greatly that it will become a difficult problem to get the binder to work properly.

The reel has an important function to perform. It must be set or adjusted from time to time during its work in the field so that it will lay the grain over onto the platform in the neatest manner possible. The lever for doing this is usually within easy reach of the man on the seat of the machine. The reel should be set to strike the grain near the head so that it will lay it over evenly. This applies to standing grain. When the grain is lodged, it will be necessary to move the reel as low as possible and as far forward as can be to get this lodged grain lifted to the sickle to be cut and onto the platform canvas.

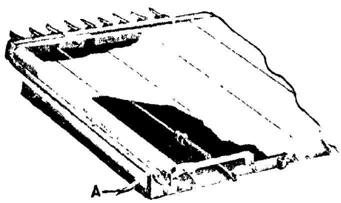


FIG. 124.—Platform canvas-release lever.

The grain deck or binding deck, as it is also frequently termed, is directly over the bull wheel and receives the cut grain from the elevating canvas. On this deck the butter is located. The packers also come through the deck and pack this grain into bundles where it is bound. The purpose of the butter is to make sheaf which is even and straight on the bottom so it will stand up in the shocking. It is important that the butter be set square with this deck. In other words, it should make the bundle square on the bottom so it will stand easily.

The Knotters on all binders are very nearly alike. The purpose is to tie the twine into a knot and thereby hold the grain and straw together in what is commonly termed a sheaf or a bundle. This knotter mechanism is not at all complicated nor in the least hard to understand. It is, however, a delicate

part of the machine and should not be tampered with as would be the case with other mechanisms. A hammer or cold chisel, or any tampering with tools, may ruin it. It is also important that this tying mechanism or knotter be adjusted so that the twine will go about midway between the extreme length of the grain being handled. If on any one side of the center, it should always be toward the head rather than toward the butt.

The tension on the twine is a thing that needs some care to be sure that there is no slack and just the proper tension

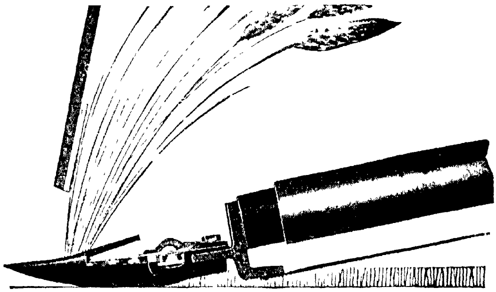


FIG. 125.—Section through cutting mechanism, showing action of reel on cut grain.

so that the needle can take up the slack when tying the bundle. If this tension is too tight, the twine is apt to wear a groove in the needle eye and twine discs. This will cause trouble with the tying mechanism Never try to determine the size of the bundle by the tension on the twine.

If it is desirable to tie large bundles, the tension on the trip dog spring should be increased This moves the arm of the compressor back. On binders which have a separate trip and separate compressor, this spring should be tightened when the compressor is back. For tying grain that is green or damp, this order should be reversed since what was said above refers particularly to grain that is dry and well matured.

Grain that is badly tangled frequently causes trouble at the discharge and plugging is a common fault. This can be overcome by adjusting the compressor and trip for tying a smaller and looser bundle. It is highly important that the knotter mechanism be given a thorough tryout, particularly on new binders before any changes whatever are made. This knotting or tying mechanism has been thoroughly tested at the factory where the machine was built and was found in perfect working condition before it was sent out. In the painting process, however, parts may have become slightly "gummed-up" and

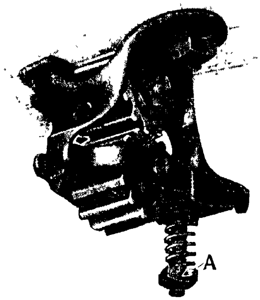


FIG. 126.—Twine tension device.

somewhat stiff. This is not a complicated mechanism and by studying it, as the machine runs empty, it will easily be understood. All the parts are timed with each other so that the knot may be properly tied and in removing or replacing any parts this should always be carefully noted to be sure thay are put back in proper time.

A new machine, as said above, will frequently work a little bit stiffly and many bundles may be turned out that are not bound. In a short time, however, these parts will loosen up and work properly. After a time bundles may again be

turned out that are not bound. The twine knife, which, like any other edged tool, gets dull, probably needs to be sharpened. A small whetstone will be found a convenient means for doing this work. The original bevel of the knife should always be maintained. No grinding is necessary on the knotter and a file should never be used on this mechanism. If bundles are not properly tied, this may be traced up in a systematic manner from the twine box to the knotter and the trouble discovered.*

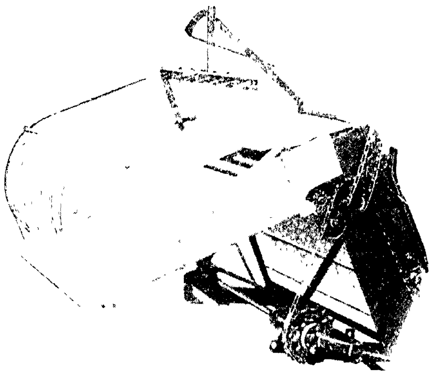


FIG. 127 Flax-bunching attachment for binder

The illustrations following Fig. 133 show the various defective ties that are most common and together with the explanation and remedy will prove of interest to the purchaser of a binder. If the band is found clinging to the knotter hook or bills with the free end cut off square (as at 1), it indicates that the twine disc is too loose or the twine tension too tight. The remedy is to loosen the tension, and if this does not correct the trouble, tighten the disc spring slightly.

If the band is found on the knotter hook or bills with a loose and ragged or crushed end (as at 2), loosen the tension

* See Farmers' Bulletin 947, "Care and Repair of Farm Implements"

on the twine and if this does not relieve the trouble, loosen the disc spring a trifle.

If the band is found with the bundle with a single knot in one end (as at 3), but the free end cut off square, tighten the disc spring, and if this does not overcome the difficulty, examine the disc for wear. If badly worn, the only remedy is to replace the disc with a new one. If this occurs regularly

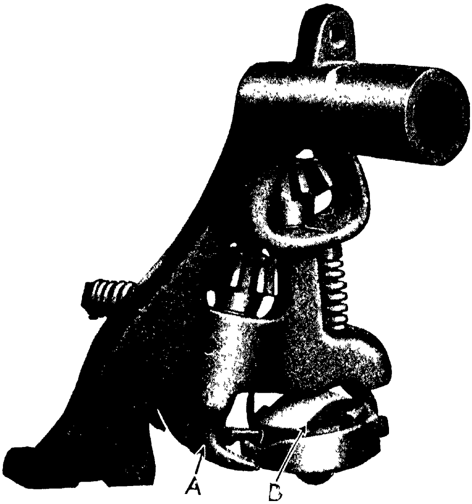


FIG. 128.—Knotting device for binder.

with each fifth, sixth or seventh bundle, look for wear in one notch of the disc. A very loose or broken twine tension may be the cause of the twine not being stretched tightly across the knotter hooks or bills.

If the band is found with the bundle with a single knot in one end and the free end ragged or crushed (as at 4), the twine tension is correct, but the disc spring is too tight. The remedy is to loosen the disc spring.

If the band is found with the bundle, but both ends free from knots and straight and each end ragged and crushed (as at 5), the tension is right, but the disc spring is very tight. The remedy is to loosen the disc spring

If the band is found with the bundle, but both ends free from knots and folded showing that the knot was formed but not completed (as at 6), examine the knotter hook or bills. The knotter hook or bill spring may be too loose or the

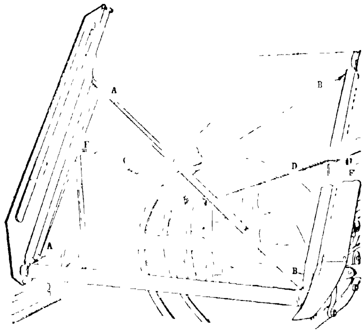


FIG 129.—Squaring frame for canvas rollers.

hook or bills worn so badly that the ends were not held sufficiently tight to form a knot The remedy is to tighten the knotter hook or bill spring or, if excessive wear is present, replace the knotter hook or bills and shaft complete.

If the band is found with the bundle or clinging to the knotter hook or bills (as at 7), in some cases with the knot perfectly formed but the band broken, the trouble may result from the knotter hook or bill spring being too tight when tying loose bundles. The remedy is to loosen this spring slightly, or set the trip and compressor arm to bind larger and tighter bundles. It may be caused also from a worn cam roller on the stripper arm. The remedy is to supply a new stripper arm complete.

If the bundle is tied with a slip noose (as at 8), with the twine extending from the discharged bundle to the needle eye, the needle has failed to place the twine in the disc holder, because of excessive wear in the needle eye itself. If the needle eye does not have a special wearing piece, the only remedy is to supply a new needle. In replacing the needle the point should protrude slightly above the deck when the needle is at rest.

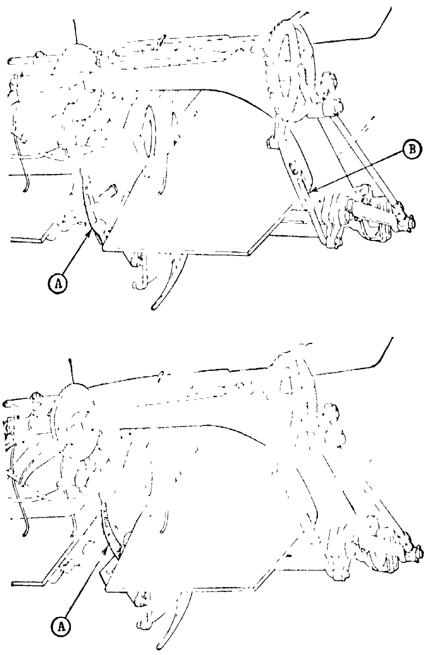


FIG. 130.—To make small bundles, lever A should be moved upwards. For large bundles it should be moved down. Tightening B makes tighter bundles.

On some makes of machines, sometimes the bundle is tied properly but with a bowknot in one end. This knot simply includes the short piece of twine which other makes of machine cut loose and which is lost by the machines that tie a hard knot. This knot withstands rough handling as well as a hard knot, and is not a real waste of twine. Knotters properly adjusted will not handle twine that is not reasonably uniform. The remedy is obvious.

Capacity.—The amount of grain cut in a day depends on the rate of travel, the condition of the grain, whether standing well or lodged, and the condition of the binder and the skill of the operator. Theoretically a 7-foot binder traveling at 2½ miles an hour should cut 20.98 acres a day of 10 hours. Figures obtained by the United States Department of Agriculture (Bulletin No. 814), showed that with horses the average is 15.1 acres per day while the average binder is 7 foot. This is 2.15 acres per foot of grain cut. It is easily possible to travel 3 and even 3½ miles an hour with a special tractor binder which materially increases the capacity for work. It is safe to assume that from 3 to 3½ acres per foot may be cut in a day. This would be from 21 to 24½ acres per day with a 7-foot binder. A 10-foot machine would cut from 30 to 35 acres a day. In fact, as many as 50 acres of oats have been cut in a 10-hour day with machines of this sort.

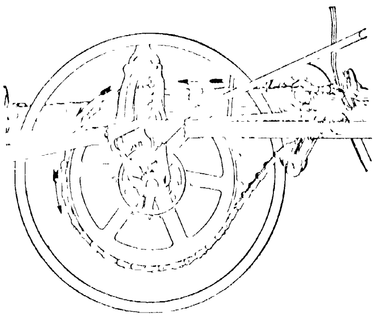


FIG. 131.—Bull wheel chain-drive, properly put on, and raising device.

Draft.—This problem of draft is one that depends upon the kind of grain being cut, the yield, the soil, and the condition of the binder, and its various bearing parts. Hills, too, are a big factor, for it is easy to understand that pulling up a hill adds to the draft of any machine. In general, it may be stated that the average draft of 8-foot binders, used at about two miles an hour, cutting average wheat on level land with good footing, is about 700 pounds per machine. The kind of grain cut and the yield affect this figure. It varies from 650 to 950 pounds. A good general average is 90 pounds per foot

of sickle bar. Tests have been made which reveal that the draft may vary considerably. On a new 10-foot machine that is well lubricated and in first class condition, this figure may be as low as 650 pounds. Then again, on a machine which has been used for a few seasons, the bearing badly worn, and

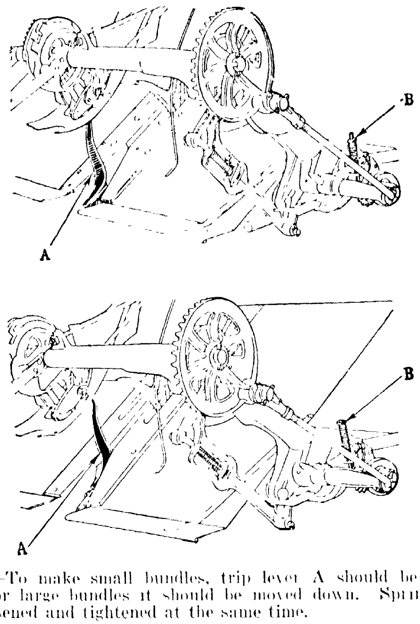


FIG. 132.—To make small bundles, trip lever A should be moved up; and for large bundles it should be moved down. Spring B should be loosened and tightened at the same time.

the machine out of square, this figure may be as high as 1200 pounds. In some cases where this condition is very severe and aggravated by tight canvas aprons the draft may be as much as 1500 or 1800 pounds. In fact, it may be such that the bull wheel slips on the ground without even turning. A machine equipped with high grade anti-friction bearings will show a draft of from 18 to 25 per cent less than these figures. An-

other thing was revealed by field tests which is interesting, and that is that as the rate of travel increases, the draft decreases. In one series of tests on a 10-foot machine where the speed range was from 1.51 to 3.53 miles per hour the draft was 930 pounds and 750 pounds respectively. This shows a decrease of 20 per cent in draft

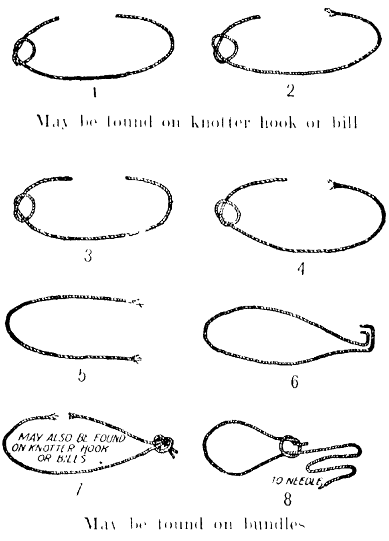


FIG. 133 Examples of defective binder ties

GRAIN SHOCKERS

This machine is used as an attachment to the regular grain binder. It cannot be used alone since its function is to make a shock of the bundles as they are dropped by the grain binder. It is a trailer machine and derives its power from the binder to which it is hitched. It is not used in a general way like binders and is made for use with but two or three prominent

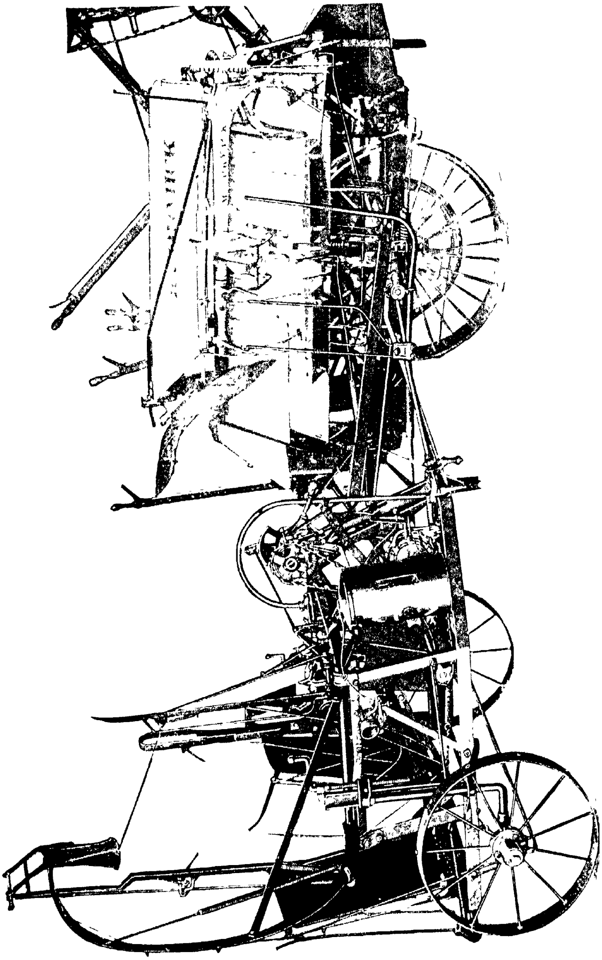


Fig. 134.—Grain shocking attachment.

makes. It may be used with either a six or seven-foot machine, but is not recommended for use with a machine larger than this. The hitching of this machine to the conventional binder is described on the sheet of instructions that accompany the machine. It is very important that this be followed very closely. Since this machine derives its power from the binder, it must, therefore, be hitched correctly so that it will trail properly to receive the bundles and so this power may be transmitted in the correct manner. It would be useless to

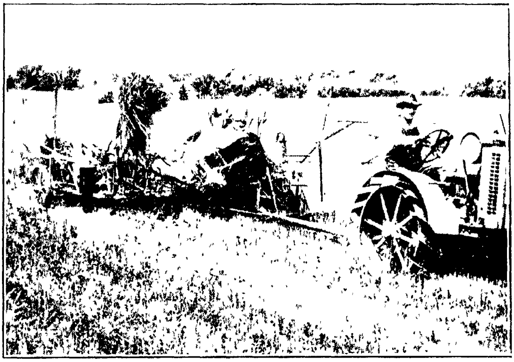


FIG. 135.—Binder and shocker

attempt to hitch this machine in combination with all the binders on the market to-day, and in a way to suit the individual farmer. It will work best on ground that is level, and it is not to be used on hilly land, nor on land that is stumpy or stony. It will not work very well in tangled or down grain and should in no case be used with grain that is cut with a sickle or badly lodged

It may be used to bind the bundles into shocks of from seven to eleven bundles. It receives these bundles as they are discharged from the binding mechanism of the binder from which point they are carried to a device called the shock

feeder. A fork moves back and carries these bundles and places them in position. These bundles are then bound with twine by a mechanism similar to that which is used on grain binders. After this is done, this attachment automatically sets this completed shock on the ground. The use of this attachment will increase the draft slightly. On ground that is very sandy it will add materially to the draft, but in hardly any case will this exceed 200 to 250 pounds. Since the binder is being drawn by a tractor, little or no attention need be paid to this slight increase in draft because the tractor will, in every case, have sufficient reserve power to take care of this attachment.

Since it is a mechanism that contains a number of sprockets, gears, cams, wheels, bearings, etc., it should get some attention in the way of lubrication to be sure that it will perform as well as the binder to which it is hitched. A tying mechanism similar to that of the binder requires the same care. What has been said in this chapter on the care and operations of binders, particularly the knotter, will apply here equally well. This attachment is carried as a trailer, and the wheels and their axles should be given the usual amount of attention so far as oiling is concerned. The success the farmer will have with this attachment is in proportion to the condition of the grain at the time of cutting, together with the care given the binder and this machine itself as a whole. It has capacity to take care of all the bundles delivered by the binder.

CHAPTER VIII

CORN BINDERS *

Function.—The purpose of this machine is to cut and bind corn into bundles. A corn binder handles a single row of corn at one time, and it should be able to handle tall or short corn equally well, on uneven as well as on level ground. Lodged or tangled corn is sometimes difficult to handle, and allowances must be made for conditions that would make successful operation of this efficient machine difficult if not entirely impossible. This machine is similar to the grain binder in that it has a cutting mechanism, an elevating mechanism, and a tying device whereby twine is used to tie the cut material into bundles.

Types, Kinds.—Since all corn binders are single row machines, there is practically but one type; consequently, they have no rating for size. There are slight differences in the mechanical features of machines built by different manufacturers. On some makes the corn is bound into bundles in a vertical position; on others, in a position more nearly horizontal.

Attachments for machines are available for elevating bound corn bundles to wagons. Attachments have been made for shocking the corn, but they are not as yet commercially practical.

Hitching.—When combined with the tractor, a corn binder should be provided with a stub-tongue. Such an attachment may be obtained from the manufacturers. In some cases the fore-carriage, or tongue truck as it is commonly termed, can be dispensed with. Care in hitching should be exercised to see that it is possible for the operator of the binder to raise

* See Farmers' Bulletin 992, "The Use of Machinery in Cutting Corn."

or lower the nose for convenience in cutting short or long corn and corn that is pretty badly lodged.

It is also a good plan to provide a wood break pin in the clevis so that there will be no danger of injuring the machine seriously if an obstruction is encountered.

There is very little about hitching a corn binder to a tractor which is at all difficult. Caution must be used, of course, in turning at the ends, since this turning will be the most difficult

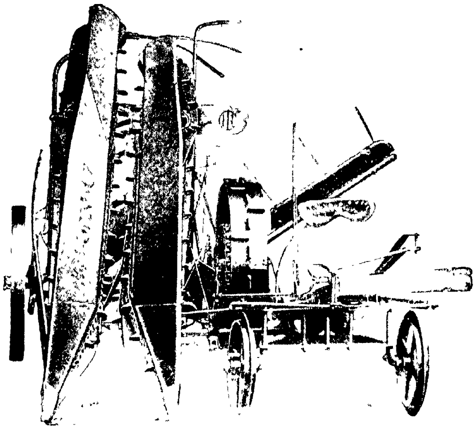


FIG. 136.—Conventional corn binder, front view.

part of the field operation. If the tractor is wide, it is important to hitch to one side so that the traction wheel will have clearance and not run so close to the standing corn as to damage any of it.

A remote control that permits operating the tractor from the seat of the corn binder may be used. This requires only one man to run the outfit. On machines where the operator of the tractor rides on the binder itself, the binder thereby becoming a part of the outfit, it will be equally important for the hitch to be made exactly right. Hitching irons and

directions covering the hitch will accompany the machine in such cases. These instructions should be followed closely since variations in a hitch of this sort may be disastrous for final results. When properly coupled in this manner the outfit makes an ideal one-man outfit.

Field Operation.—Since most corn binders are provided with means which facilitate leveling the machine, the operator should give this first consideration The machine should be adjusted to the height of the stubble to prevent cutting so low that the sand and grit from the ground, which has been

FIG. 137.—Corn binder and tractor, with one operator for both.

washed onto the stalks by rain, will rapidly dull the cutting device.

The greatest advantage of the combination of binder and tractor lies in the fact that cutting can be done at a more rapid rate than with horses Even a slow, steady, uninterrupted travel will accomplish a great deal in a day. Farmers putting up silage will find this of particular advantage, since one-row binders rarely have the capacity to enable a farmer to keep the silage cutter running at its maximum capacity. The tractor drawing the binder will be a means of getting more work out of the tractor, the binder, and the silage cutter.

Directions for oiling the grain binder, in the chapter on this subject, will apply to corn binders; and what was said about the knotter, also in the same chapter, applies to corn binders since these knotters are almost identical and have at least the same function to perform

Corn is one of the hardest of all farm crops to handle. The stalks, in many cases, are thick and the corn very tall. Harvesting a heavy stand of corn for shocking purposes when it is dry and the weather is cold and raw is hard for both the

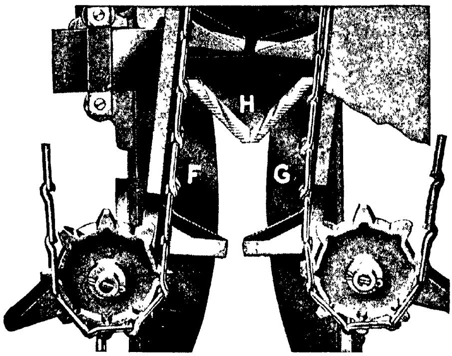


Fig. 138.—Cutting device on corn binder. H, movable knife; F and G, stationary knives.

machine and the operator. The machines, therefore, are worked to capacity since such heavy material is being handled. It follows that attention must be paid to oiling to make sure that the machine is kept in fit condition. A good grade of light oil that will flow freely from the spout of an oil-can is a satisfactory lubricant.

The elevating chains need particular attention. These travel at an angle and convey the corn that has been cut to the packers, where it is prepared for being tied into a bundle. The lower end of the chains, the idler ends, should be amply lubricated. In addition, they should be kept tight enough to

do the work for which they are intended. It is impossible to expect good work from this machine unless these chains are working properly. On nearly all corn binders they may be tightened by a very unique device at the lower, or idler, end

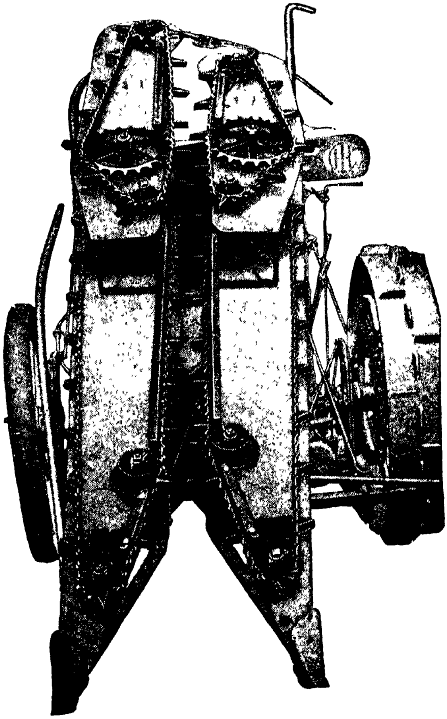


FIG. 139.—Elevating chains.

of the chains. It will require two wrenches to do this, one of them an "S" wrench and the other any kind that will fit the lock nut on the bolt. Some judgment should be used not to set the chains so tight that there is danger of breaking them

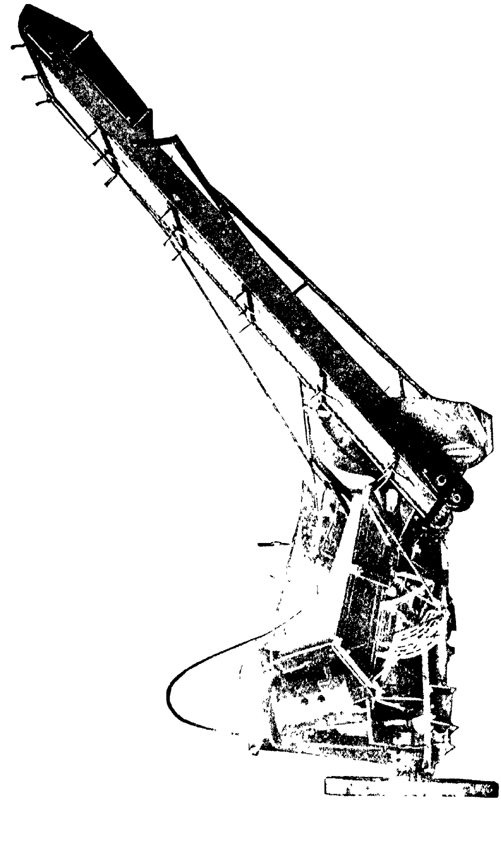


FIG. 140.—Bundle elevator, used largely for handling silage corn.

or wearing out the bearing stud on which the sprockets run. Such extra and unnecessary tension also wears out the chains rapidly and besides that increases the wear on all the parts and makes for heavy draft

Where bundle carriers are a part of the corn binder they need careful watching to be sure that they work well Oiling them—particularly the upper or outer end—is frequently necessary. The trailer wheel on such attachments needs frequent oiling also. The chains should be so set that they work

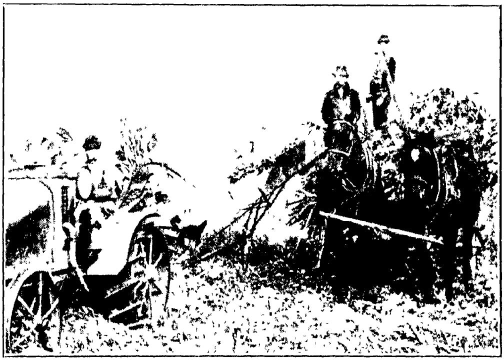


FIG 111 An economical means of handling corn for silage.

well on the sprockets without binding The clutches should be given some care to be sure that they engage properly and have a good hold. The jaws should always have a full bite. Foreign materials often get into the jaws and keep them from getting a full grip.

It is well not to throw in the clutch too late when starting to cut a row of corn, but to engage the mechanism easily instead, and when the machine is running free rather than under load. All gears on the machine, particularly the bevel gears driving from the cross shaft to the chain elevator shafts, should be greased frequently. It is advisable to see that they

mesh properly at all times, for unless they do they will wear out rapidly. If they need resetting at any time this should be done, very carefully and accurately.

Capacity.—The capacities of corn binders vary slightly. The greatest factor entering into consideration is the speed at which the machine is operated. Cutting corn at the rate of two and one-quarter miles an hour, about six acres a day of ten hours, is all that can be expected. This is on the basis of corn planted in rows forty-two inches apart.

Traveling, with tractor power, from two and one-half to three miles an hour, or even three and one-quarter miles per hour, with a special corn binder for tractor use, it is possible to cut nine acres per day of ten hours. Checked corn has been handled successfully with this machine and a tractor cutting ten or eleven acres. Cutting this amount is easily possible, particularly when the corn binder and tractor are hitched together as one unit. Small fields reduce the capacity of a corn binder or any other machine, whereas large level fields increase the capacity. The greater capacity is due to the fact that considerably less time is lost in turning at the ends.

Under favorable conditions it is safe to figure on cutting an acre an hour.

Draft.—The draft of the machine is influenced by the yield of the corn. It is also influenced by the height—a factor which makes for a given volume. Cutting drilled corn will require about the same power as cutting checked corn, because nearly the same volume is handled per acre. Cutting silage corn, which is green and wet, requires less power than cutting corn for shocking, which is dry. The average draft of corn binders cutting drilled silage corn, yielding 50 or 60 bushels to the acre on level land, was found to be 480 pounds. Cutting checked corn for shocking was approximately the same. The tests were made on level land that was hard. Cutting corn after a rain when the ground is soft would necessarily increase these figures. In extreme condi-

tions, the draft has been found to increase as much as 40 per cent due to working in a wet field. The influence of speed on the draft is very slight. A bundle elevator will increase the draft approximately 100 pounds.

CHAPTER IX

PUSH BINDERS AND HEADERS

Function.—The purpose of the push binder, like that of the conventional binder, is to cut and bind grain into bundles. A push header is similar to a push binder except that it is not provided with a binding attachment As its name indicates, it merely heads and elevates the grain to a header wagon, commonly termed a header barge. This machine is used mainly for cutting very short grain or often alone for headed grain, and since the amount of straw it handles is small, the platform and cutting mechanism is wider. In some cases the bundles are conveyed directly into the header wagon, or they may be swathed They may be conveniently operated by one man and do the work as thoroughly as a conventional binder will do it, and with increased capacity because of the larger size, and the fact that the grain is headed eliminates the necessity of handling so much straw

Types, Sizes, and Rating.—Practically only one type of push binder is on the market. Different makes have different mechanical features, yet the characteristics are largely alike. Most manufacturers make these push binders in what may be termed combination machines so that they can easily be converted from one to the other. This means that they may be used either as push binders or headers. These machines are made in sizes of from 10 to 14 feet; 12-foot machines being the most common size. This figure of size is the length of the platform and cutting mechanism, and its rating is similar to that of regular grain binders or mowers. Attachments are provided for elevating the bundles directly into a wagon box and for bunching flax.

Headers, however, are not made so that they may be converted into binders. Headers usually are made larger and the 14-foot size is most common. Rating for size is the same and refers to the swath the machine will cut. A header wagon traveling alongside the machine receives this headed grain, and it is then conveyed directly to the threshing machine.

Hitching.—When horses are used with a push binder or header they are hitched behind the machine; when a tractor is used, this binder or header is drawn by the tractor just as is the conventional binder. Some changes, however, are necessary to use these machines successfully with the tractor. They

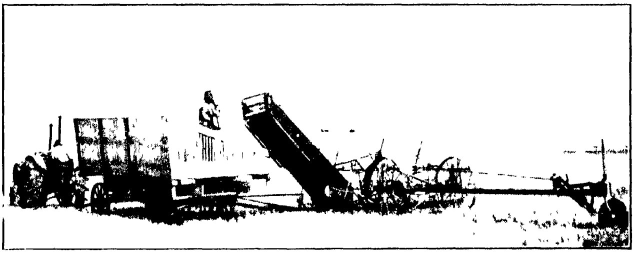


FIG. 142.—Header in use with header barge, both being drawn by tractor.

are so wide that they must be handled differently. The operator stands at the rear to guide the machine with what is termed the "tiller wheel," where all levers controlling the platform and reel are located. One man can guide and operate these machines successfully from this position.

Because of the peculiar construction, the hitching must be done so that the tractor can travel a considerable distance ahead of the machine itself to permit running the tractor on the stubble. Attachments may be procured to handle this work in a satisfactory manner without danger of trouble from any source whatever. It is useless, however, to attempt to hitch the machine to a tractor without these attachment irons or chains, because the frame of the machine is apt to be pulled

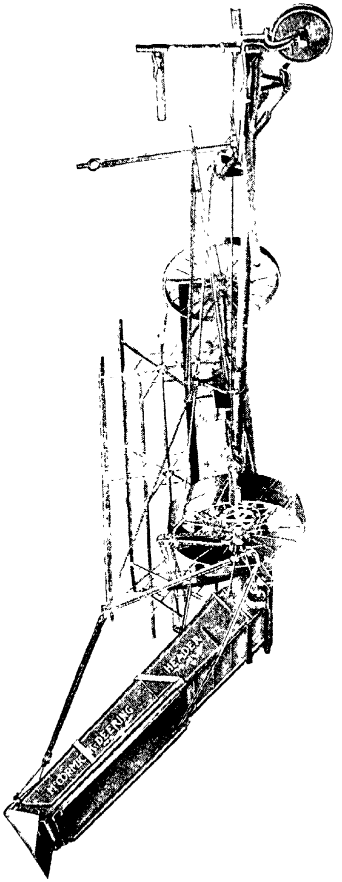


FIG. 143.—A grain header

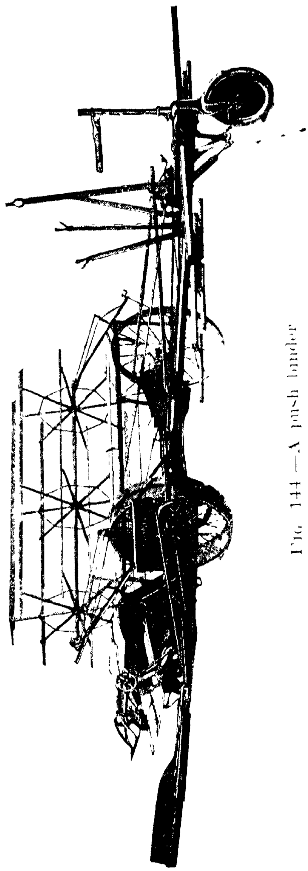


FIG. 144.—A push binder

out of shape if some other means than that recommended by the manufacturer is used. Since the hitch is so far ahead of the machine proper, no attention need be paid to the distance in height of the draw bar of different tractors. The hitch attachment in all cases should be secured to the main axle or parts adjoining it. This part is the main support of the machine, about which the whole machine is built.

If, for any reason, the side draft becomes excessive, it will be necessary to lengthen the hitch to eliminate it at least to some degree, but this is very unlikely. This, however, should not be done without being sure that no other elements enter into the problem. Since the machines are always used in large fields, this can be done without danger of limiting the work of the machine as a whole. Manufacturers furnish all the necessary materials to go with a complete hitch, and it is desirable to

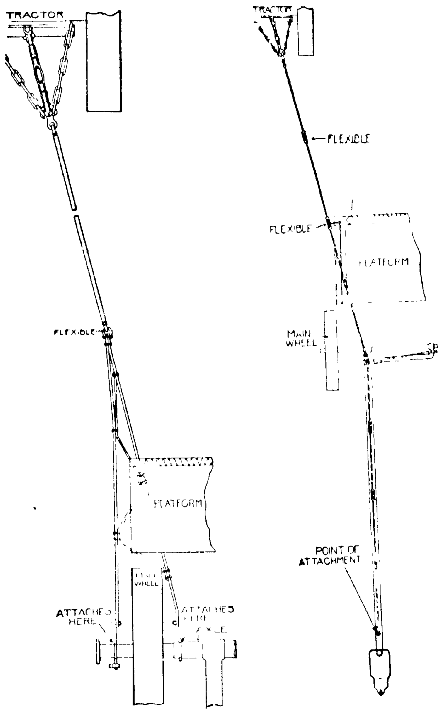


FIG. 115.—Tractor hitches for header.

get these parts from the manufacturer of the particular binder or header. It must be remembered that these hitchings should in no way interfere with the handling of the machine in the field. Neither should they in any way interfere with flexibility of the outfit. If directions are followed closely in doing this work, satisfactory operations are bound to result.

Field Operation.—What has been said about the field operation of grain binders will apply to these push binders in detail. This same information will also apply to the push headers. Both of these machines have all the characteristics of the grain binders and they do the work of harvesting a grain crop in a similar manner, except that the push binder and header usually handles a minimum amount of straw. The most important thing in the operation of these machines is to be careful not to cut so close that heads will be left standing with the stubble.

Capacity.—The amount of work that one of these push binders or headers will do in a day depends principally on the rate of travel and the size of the fields in which the work is being done. Ordinarily a 10-foot machine will cut from 20 to 25 acres a day. A 12-foot machine from 25 to 30 acres a day and a 14-foot machine from 30 to 35 acres a day. This is in fields of average size and at a rate of travel of from 2 to 2¼ miles an hour. An increase in these figures may be had by running the tractor a little faster, but it is not advisable inasmuch as these machines are primarily designed for use with horses. At a speed of from 2½ to 2¾ miles an hour it is easily possible to cut 15 to 20 per cent more in a day.

Draft.—The draft of one of these machines varies with the yield of grain. Ordinarily from 650 to 800 pounds will be required to pull a push binder of this sort. A push header will require from 550 to 700 pounds under average conditions. Under very favorable conditions a draft of from 525 to 650 pounds may be encountered.

CHAPTER X

COMBINED HARVESTERS

Function.—The combined harvester is a combination header and thresher. Some manufacturers use the term "Header-Thresher" for it. Its purpose is to head the grain, and to thresh and clean it while moving over the field It can be used in those localities where the grain matures uniformly

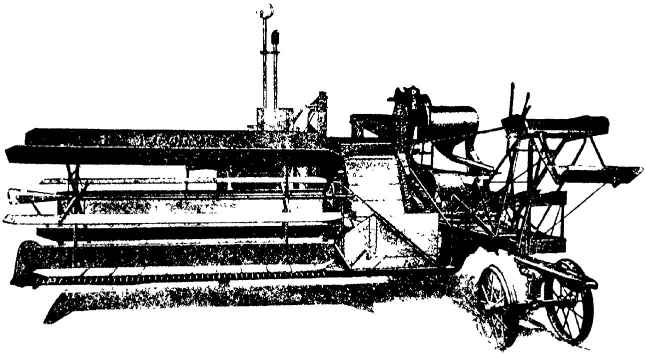


FIG 146 A combined harvester

and ripens completely on the stalk. These localities are California, Washington, Oregon, Idaho, and that part of the Northwest where grain is grown. Recently it has found favor in that section of the country just east of the Rocky Mountains where during certain years conditions are such that the machine will do satisfactory work. It should cut grain of varying heights, thresh it, and clean it in a thorough manner ready for bagging. It should pull easily and be operated

by a minimum number of men in the most convenient manner.

Types, Sizes, and Rating.—There are two general types of machines, namely: the drawn machine and the self-propelled. The former is usually hitched to a tractor, whereas the latter propels itself. The drawn machine may be divided into two classes: the level land and the hillside types. The former is one that has a rigid axle and is for use only on level ground. The latter contains a leveling device so that the machine can be used on sides of hills such as are found in the wheat sections of the Northwest. The machine is also used for

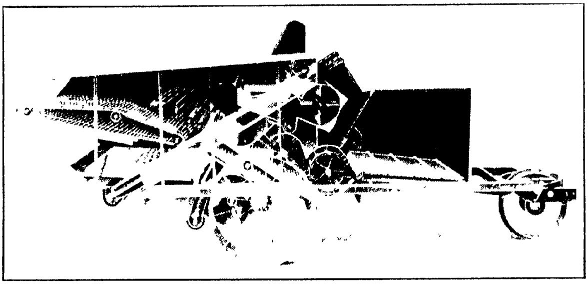


FIG. 147.—Sectional view of typical combined harvester.

harvesting beans on the West Coast where they are raised on large areas.

The sizes of these machines vary from 9-foot size, which, like a binder, represents the swath being cut, to 24-foot machines, which are large machines used in the West. Most of the small machines of from 9 to 12-foot size are made to use on level ground. The thresher size is in proportion to the cut and varies from 20 inches to 36 inches. The rear of these machines, that is, the separating part of the thresher, is usually a little wider and will vary from about 36 inches to about 54 inches. The two sizes, therefore, represent the size of the thresher itself. (See paragraph on this subject in Chapter XVIII.)

Hitching.—This is a comparatively simple job, as practically all of these machines of the drawn type may be provided with a tractor hitch. The hitches are usually placed so that they are convenient to hitch to and the element of side draft eliminated. The hitch on some of the small machines, which are trailers, traveling practically on two wheels, must be rigidly fastened to the draw bar of the tractor, particularly in the case of small machines of 9- and 10-foot cut which do not have a fore-carriage truck. The larger machines have

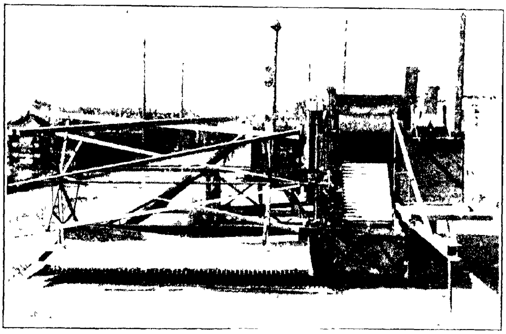


FIG. 148. Front view of combined harvester, showing platform and draw bar

a third wheel, or fore-carriage, forward of the machine, which is also the steering wheel or wheels, and in such cases hitching may be done by means of this stub tongue provided with a clevis. These machines, "combines," as they are termed, are provided with brakes to hold them when going down steep inclines. Practically all combines are driven by an independent engine mounted on the machine itself. The power from this engine runs the cutting mechanism and the elevating aprons, as well as the thresher. On some very small machines power to run the cutting and threshing mechanism is taken from the bull-wheel instead of from a separate

engine. The tractor, therefore, is used merely to draw the machine over the field.

Field Operation.—Since this machine is a combination header and thresher, it follows that what has been said in the chapter on "Grain Binders" referring to cutting mechanism, the canvases and so forth, will apply equally well to that part of these machines. What is said in the paragraph on "Threshing Machines" will apply equally well to the thresher part of this machine since it is nothing more or less than a thresher. The necessary adjustments which must be made on the cylin-

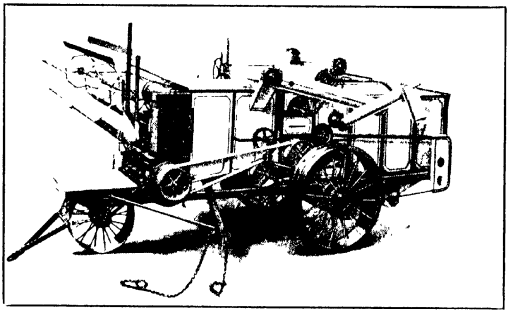


FIG. 149.—Combined harvester, provided with extension draw-chains for grain wagon. (Also note belt drive from engine.)

der and concaves, the cleaning fan and sieves, relates particularly to wheat, since it is the crop most generally handled by machines of this sort. In some of the Western states barley is often handled by the aid of these machines, in which case sieve adjustments may be made to suit this grain.

The number of men required to operate these machines will vary with their size. Ordinarily, a small 10- or 12-foot machine, hitched behind a tractor, can be operated by two men. One of them should look after the cutting mechanism, operating the reel, the platform and the clutch. This man is referred to as the "Header Puncher." The second man is

commonly called the "Sacker." This man receives the grain from the bagging spout where it is delivered into sacks which are immediately sewed up by hand. These in turn are dumped on the ground as the machine goes over the field. If the grain is to be handled in bulk and a wagon loader is used, the "sacker" is not needed. A special hitch for a wagon, to receive this bulk grain, may be had that enables the wagon to be drawn alongside the machine by the tractor. This also permits of turning and it is arranged so that wagons are easily changed. On machines of the larger type which must be leveled, it will require more help. One man, who is responsible for the machine, should look after the oiling and after the machine as a whole, to see that it is working properly and at its best. If the header puncher is an expert operator he can look after the leveling also. This on any machine should be looked after very carefully because unless the machine runs level it will not work well. On the larger machines it also usually requires two men to do the sacking.

In wheat that is very heavy, it is sometimes necessary to speed up the engine on the thresher a little bit and slow down the tractor somewhat so that the machine will travel more slowly over the ground and yet be able to do a satisfactory job of threshing. In localities where there is much dew on the grain in the morning, this should be looked after carefully in the same manner. The successful operator of a combine will see that a thorough job of threshing is done and with the minimum amount of grain wastage consistent with maximum capacity of work.

The College of Agriculture of the University of California have made some interesting investigations of work done in barley by combined harvesters and from their Bulletin No. 312 on "Mariout Barley" we find that the average shattering loss, where combined harvesters are used, is about 6.56 sacks or 12 bushels per acre. This same bulletin goes on to say that this shattering loss increases proportionately with the length of time the grain remains standing in the field. It is, there-

fore, evident that work should be done at the proper time and that these machines should be very carefully handled to get good results and eliminate the waste or at least reduce it to a minimum.

What was said about oiling binders and threshers will apply to this machine also. The cylinder, like that of the threshing machine, should receive special care to make certain that it works perfectly. The engine driving these machines must have all the attention that the engine of a tractor re-

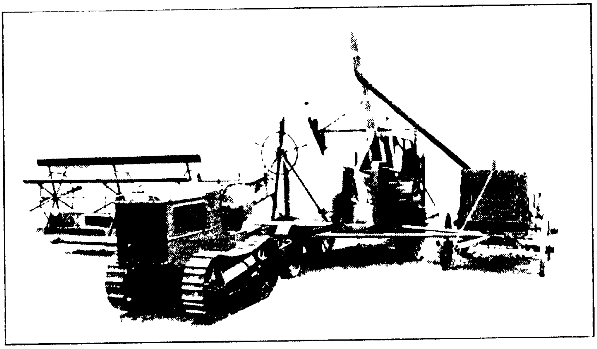


Fig. 150. Combined harvester ready to start field work

ceives, if it is to work with the degree of reliability which is necessary for success on the farm The truck wheels must be greased frequently as they carry the entire load of the machine.

When these machines are equipped with anti-friction bearings, it follows that less time need be spent in oiling them than is ordinarily spent in oiling the average plain type of bearing. They should be oiled at the beginning of the season with a high grade lubricating oil. When grease is used, a light high-grade grease should be purchased. In such cases it would hardly be necessary to fill the bearings oftener than once a week Where light oil is used for the threshing cylin-

der, it is sufficient to oil these bearings every three or four days.

This machine may be used for threshing from the shock or from the stack. In such cases the heading mechanism may be detached and the machine set like a regular threshing machine. What has been said about running a thresher will again apply equally well to the operation when this machine is used as a stationary thresher. In such cases, however, the capacity is reduced These machines are made primarily to handle headed grain and if shocked grain is to be threshed,

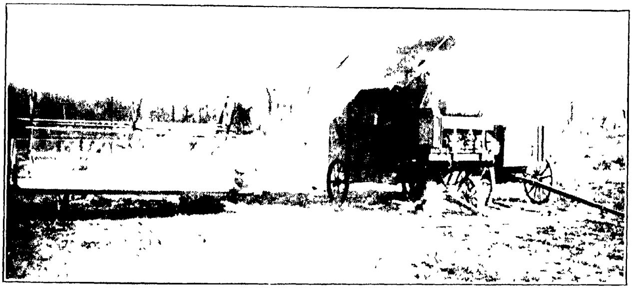


FIG 151.—A special thresher used in combination with a header, making a combined harvester and thresher unit

reduced capacity must be expected if good threshing is to be done.

Where bundle grain is fed to the machine, it is important to be sure that the bands are always cut and the bundles very carefully fed to the machine This can best be done by rigging up a stationary hand feeding device. If, however, only a small amount of grain is to be threshed in this manner, the heading mechanism may be left on the machine and this grain fed directly to the platform canvas which will travel in the customary way to the cylinder.

Capacity.—One of these small 9- or 10-foot machines is able to handle wheat on the average farm at the rate of from six-

teen to twenty acres per day. This is at a speed of about two and one-quarter miles an hour. Where the grain is in good condition, and even though the yield may be above the average, the machine may be worked at a little faster rate of travel, and it is possible to cut twenty-five to thirty acres a day with a 12-foot machine.

When machines of the 16-foot or 20-foot size are used, it follows that more work can be done and it is not uncommon to find machines of this size cutting from forty to fifty acres a day, working on level land. In the hilly country work will

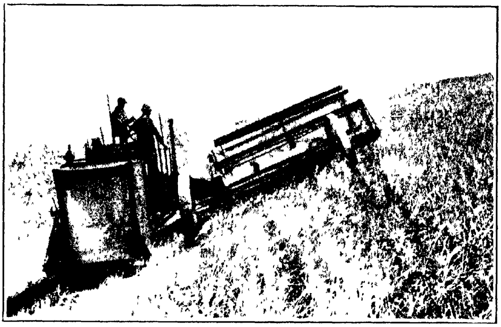


FIG. 152.—Field scene, showing combined harvester of the hillside type.

be done more slowly and the number of acres covered in a day will be less. Large machines will do correspondingly more. A good average figure which may be used, when the conditions of the grain are ideal and on level land and tractor drawn, will be $2\frac{1}{2}$ acres per foot of cut. A 10-foot machine, therefore, should be able to handle twenty-five acres, a 20-foot, fifty acres, etc.

Draft.—A small 9- or 10-foot machine can be pulled on level ground with a reasonably good surface, and handling average grain, with a draw bar pull of from 900 to 1200 pounds. On sandy soil, this draft will run from 1200 to 1600 pounds.

If the machine is to be used on a hill, the draft will be materially increased. A large 20-foot harvester, used on the side of a hill in the loose soil of the Palouse country, will require from 2800 to 3500 pounds to pull it, depending on the conditions of the soil on which it works, plus the condition of the grain, that is, its yield and also the degree of care that was given in the way of lubrication of the machine. The soil is one of the greatest factors because in a slightly sandy soil, particularly where the volcanic ash soil predominates, this figure of draft frequently becomes a big item.

Repairs and Care.—What has been said with reference to the care of binders, particularly the cutting mechanism, will refer to the same mechanism on this machine. What is said on the subject of Repair and Care of Threshers will apply equally well to the threshing mechanism of the combined harvester.

CHAPTER XI

MANURE SPREADERS

Function.—The purpose of this machine is for handling manure to be used as fertilizer in the soil. Machines of the conventional sort have some of the charasteristics of an ordinary farm wagon However, because they work in the field, and also because the power received from them must be applied to the spreading device, the wheels have wider tires. This power must be taken from the rear wheels, which have provision for transmitting the power to the spreading mechanism. The spreader should be low to facilitate loading, should draw light in the field, and, in unloading, spread the material on the land uniformly.

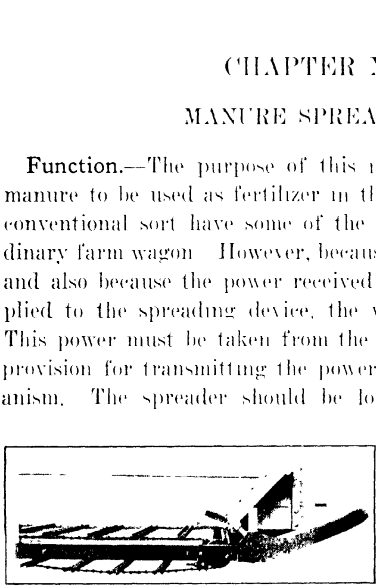


FIG. 153.—Drag style, endless apron type, front end

Types, Sizes, and Rating. — Manure spreaders are made in two general types. One is made with what is termed an "Endless Apron" and the other is made with what is termed the "Return Apron." The endless apron may be a tight bottom or drag chain style. On various machines, the beater and wide-spread cylinder differ slightly. Various devices are used in the way of chains, gears, and cams to alter the amount of material that is being spread. This is done because some soils require more manure than others. The change is easy to make and is also very essential. Attachments for spreading lime may be purchased

to put on some makes of spreaders. Straw spreading may be done by the aid of a special attachment like a rack to hold a large quantity of straw.

The size of these machines is usually given in terms of capacity to handle a given number of bushels at one time. Some machines are rated in capacity figures of pounds. Such rating of the machines is very indefinite, because manure varies in weight and density. The rating of a machine in bushels would, therefore, be subject to the same error as rating in tons or pounds. Some manufacturers use a number or letter to designate a size such as size 2 or size B. It may be seen that all the manufacturers' rating figures are not on a comparable basis. The average farmer can, however, very easily select the machine size best suited to his needs according to his own judgment and general knowledge of capacities, because he is familiar with such items.

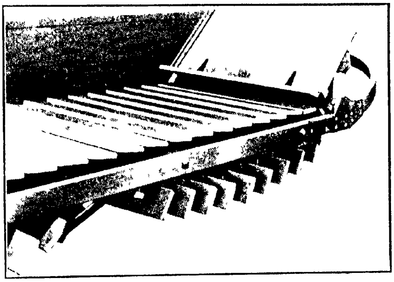


FIG. 154. Tight bottom, endless-apron type.

Hitching.—It is comparatively easy to hitch one of these machines to the conventional tractor. About all that is required is a stub tongue with a clevis for the end. This clevis may be nothing more or less than two wrought straps above and below the tongue, with a pin passing vertically through the end. This arrangement permits hitching the machine directly to the draw bar of the tractor. Here, too, care should be exercised not to hitch so close that in turning short the tractor drive wheels interfere with the front of the spreader. On tractors that have a low draw bar the tongue should be set proportionately lower, and on many spreaders this is possible.

It might even be necessary in some cases to make iron attachments for the tongue with some vertical adjustments like those on a grain drill to facilitate hitching to a tractor with an extremely low draw bar. The thing to watch particularly is to see that where a low draw bar is used that the pull is not downward on the tongue in an excessive amount which brings an unnecessarily heavy load on the front wheels of the machine. If there is such a tendency, the hitching device should be lengthened which will help to overcome such trouble. There is no danger of getting a hitch that is too high with the conventional type of tractors in use today, because most spreaders are hitched about the height of traces used with horses, and this arrangement is satisfactory.

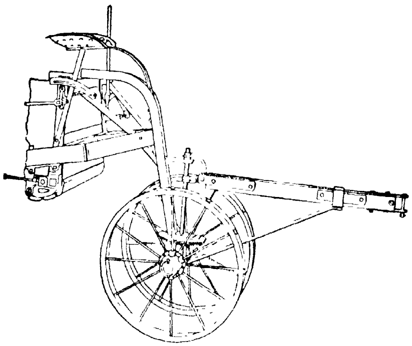


FIG. 155.—Stub-pole with hitch-clevis.

Field Operation.—The spreader is not an intricate machine, although there are gears, sprockets, chains and ratchets of various kinds and sizes on various machines which will require some attention in the way of lubrication. It is a good plan to oil the machine thoroughly each morning and noon before starting out. The wheels, particularly the front wheels, should be well greased, and the rear axle bearing should not be neglected because it carries a heavy load. The beater, regardless of its location or style, has heavy work to do and rotates quite rapidly, so it needs oiling very often. The wide-spread cylinder, although having considerably less work to do, travels at a good rate of speed and should be

oiled carefully and frequently. Where idler gears or idler sprockets of various kinds are used, they need watching to be sure that they operate without trouble.

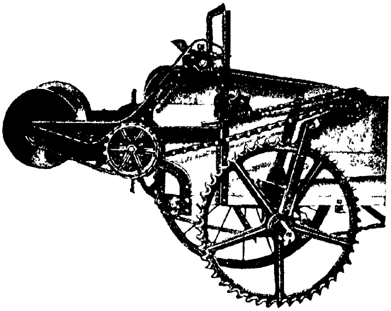


FIG. 156.—Driving device for beater and widespread.

The chains should always be kept in fit condition so there is no danger of their breaking. They should never be so tight that there is danger from this source. They should not be allowed to get so loose that they will climb the sprocket and

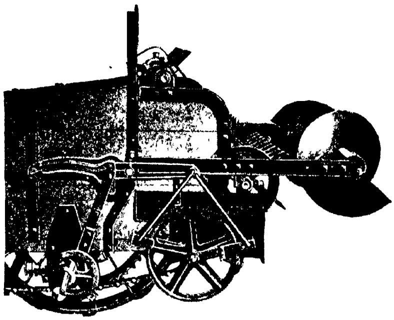


FIG. 157. Speed change mechanism.

increase the tension to the breaking point. Whenever pintle chains are used, they should be oiled frequently. Since these machines stand out of doors practically all the time, par-

ticular attention should be paid to the oiling of all rubbing surfaces.

On modern spreaders provisions are made for spreading the manure on the land in varying quantities. Rich land requires less than poor land. Adjustments for varying this quantity may be made on the machines and this should be set to suit the field conditions. On most machines adjustments of this sort can be made, and the machine is marked so that if it does become disturbed it can always be set back to the original mark if the place is remembered.

It is well not to attempt to do too much with these machines, particularly in handling material that is very heavy. The

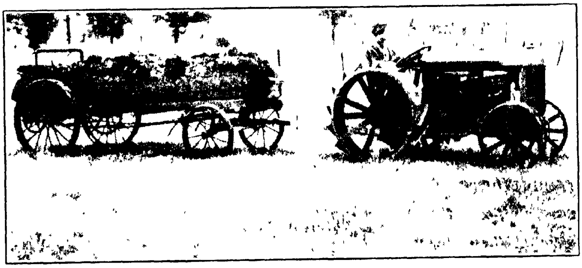


FIG. 158.—Conventional spreader, hitched to tractor

aprons, whether of the return type or endless type, should be watched carefully to see that slats, when broken, are replaced immediately. If a slat should become broken the best thing to do is remove it immediately and replace it with a new one at the earliest convenient time. Some care should be used here to see that the new one is exactly the same shape and size and that the holes are drilled in the proper place so that the chain is not spread or drawn together.

Where high grade roller bearings are used on these machines, whether they are on the axle, on the beater, or on the wide-spread cylinder, the need for oiling every time the machine is used is eliminated. In such cases these bearings

should be removed once a year and cleaned with kerosene. They should be replaced and packed with a light grease, about the consistency of vaseline, or with an engine oil like that used in motor cars, and reassembled. It is not a good plan to keep a spreader loaded and let it stand, not even over night.

Capacity.—The amount of work which one of these machines will do in a day varies, and is in accordance with the amount of fertilizer spread, the distance it must be hauled, and the rate of travel. In a survey made by the University of Nebraska it was found that on 138 farms the average spreader had 67.25 bu. capacity, and that it made on an average of

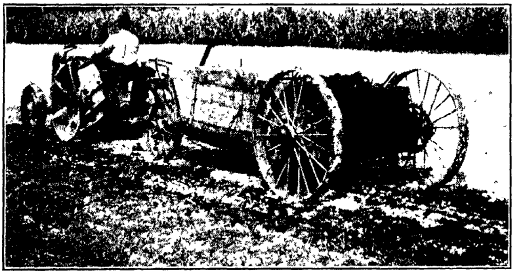


FIG. 159.—Spreader, with beater on rear axle.

12.76 trips in a day, an average trip being 125.7 rods. When used with a tractor it is possible to return with the empty machine at a higher rate of speed than when hauling a load out to the field. Added to this is the fact that spreading may be done a little faster. Of great importance is the fact that a uniform speed may be maintained which assures good spreading.

Draft.—The power required to pull one of these machines varies with many factors. It will require more draft on grade than it will on level land. Working in a sandy stubble field will require more draft than working on sod. A large spread will draw heavier than a small one. Even spreaders of the

same size often show a big difference in draft due to variations in the weight of the manure being handled. Tests made with a sixty-bushel machine, working on level corn stubble with a good footing, revealed that it required 530 pounds to pull the machine immediately after it was put into gear, and the spreading started. This decreased as the load decreased To pull this machine into the field before spreading started required 428 pounds To draw the machine empty required 160 pounds in the field, and one-half as much on the hard road To draw this machine on sod in a level field required 472 pounds. On the average, machines of this sort will require between 400 and 450 pounds on stubble and between 300 and 350 on sod when the machine is in gear and the spreading has well started. A machine well oiled and in good condition will show less draft than one poorly lubricated and badly out of line.

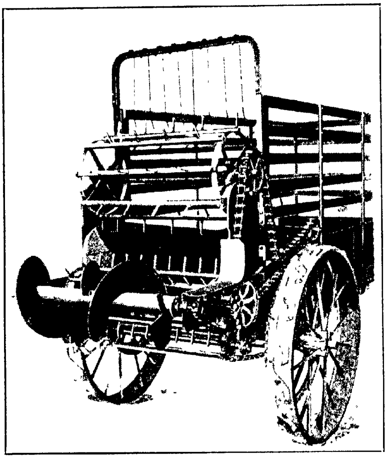


FIG. 160. — Straw-spreading attachment for regular spreader

CHAPTER XII

WAGONS

Function.—Wagons, as we all know, are for hauling loads. This chapter refers to the ordinary farm wagon used for hauling in combination with a tractor

Sizes.—Manufacturers of farm wagons have wagons standardized with reference to sizes for capacity and also to tread All standard farm wagons have a 56-inch tread This means that the wheel track is the same as that of automobiles

The following table shows the sizes and capacities of different farm wagons

WAGON GEAR

SIZE	CAPACITY			
	FARM WITH CASK SKEINS	FARM — CUMBERLAND SOUTH-WESTERN — WESTERN VALLEY WITH STEEL SKEINS	FARM CUMBERLAND SOUTH WESTERN WESTERN VALLEY WITH STEEL AXLES	MOUNTAIN — WITH STEEL SKEINS OR STEEL AXLES
Light	1500 lbs	2000 lbs.	2000 lbs.	2500 lbs.
Medium	3000 "	3500 "	3500 "	4000 "
Standard	4500 "	5000 "	5000 "	5500 "
Heavy	6000 "	6500 "	6500 "	7000 "

All gears have the size and capacity stenciled on the wagons. These size ratings take the place of the old customary size rating, which referred to the size of the skeins Wheels are of two heights for all sections, namely: high wheels 44-inch front and 50-inch rear, and low wheels with 40-inch front and 44-inch rear. The smaller size is best fitted for farm work because it is lower and more convenient.

Hitching.—To get the most out of a tractor means that whenever possible and convenient, wagonloads may be hauled singly or in trains of two, three, or even four wagons. The hitching device, while not complicated, is important. It is useless to try to use with the tractor a conventional tongue or pole not equipped with regular attaching irons. A stub tongue, first of all, should be provided, which provides means for hitching to the conventional draw bar of the tractor. If this tongue is to be made on the farm, it is well to see that it is not so short that turning corners will cause the front wheel or wagon box to interfere with the tractor wheels or action of the lugs which may be used. It may be the same style

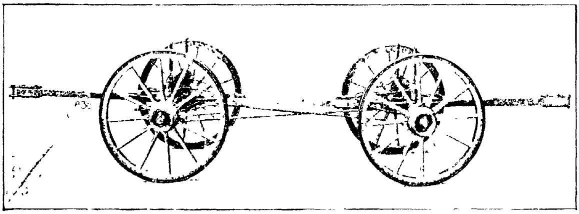


FIG. 161.—Short-turn trailer-wagon and tongue for trailer hitch.

tongue as that used on a disc harrow, or any machine coupled to a tractor. Its clevis arrangement will permit of hitching in the easiest manner and facilitate uncoupling

The conventional wagon has a tongue some 20 or 22 inches from the ground. Tractor draw bars, in most cases, are from twelve to seventeen inches Do not use a tongue that is too short when hitching a wagon to a tractor with an extremely low draw bar. This would tend to pull the front of the wagon down and bring an unnecessary load on its front wheels It may also have some effect on the tractor by tending to lift the rear. Where such a combination is to be used, the stub tongue should be lengthened a foot or two. Where the draw bar of the tractor is sixteen or eighteen inches

from the ground, and that of the wagon 20 or 22 inches, a tongue of from 5 to 6 feet in length may be used

Where this hitch is made on the farm, it should be strong enough so that it will hold the wagon when going downhill. This statement applies also to the material that is used. It is important to select a sound piece of wood that is straight

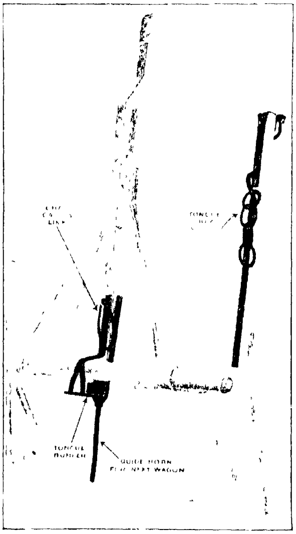


FIG. 162.—Pole bumper and guide horn for rear axle of forward wagon. Also note special pole for wagon for tractor use.

grained and free from knots or wind-shakes, in fact, the very best of wood procurable should be used for this tongue. A straight-grained, hard wood such as ash, maple, elm, or hickory, if it is perfectly straight, will do for a tongue.

Such a hitch as described would prove satisfactory for pulling a single wagon loaded to capacity behind a tractor. When two or more wagons are to be used, special devices should be procured. The illustration shows a chain draw bar which

it is necessary to use from the front axle of the first wagon to the front axle of the second wagon and so to the next A stub tongue with special attaching irons on the second and following wagons should also be used for fastening to the rear axle of the forward wagon, as shown. This special tongue for the second wagon with special attaching irons are different from those used for hitching the first wagon to the tractor. The purpose of the chain is for pulling the load instead of trying to do this by means of the reach. A hitch between the first and second wagon, as illustrated, permits of easy turning,

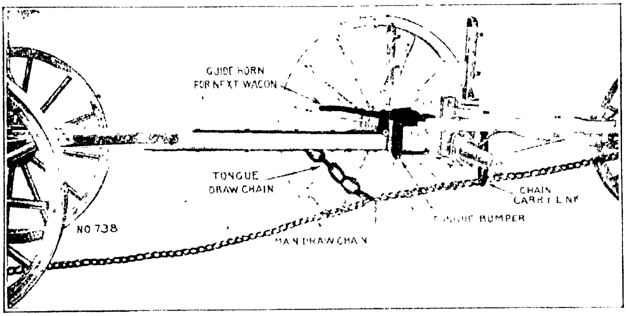


FIG. 163 - Diagram showing how second and third wagon should be coupled

and also provides a bumper for the tongue which has been found necessary and convenient to eliminate danger of breaking the rear axles or at least damaging them, or, what is more likely, breaking the tongue itself. The horn, projecting from the rear axle of the forward wagon, is the supporting means for the tongue of the trailing wagon. Its purpose is to carry the tongue when the slack is taken out of the chain, as would be the case when pulling a load. It also permits turning corners without danger of cramping the tongue or doing any other damage.

Where continued hauling is done with the tractor, it is advisable to use special short turn trailer wagon carriers.

These carriers are provided with front and rear axle turning devices and are coupled with steering rods Wagons of this sort are made extra strong, and since they are used exclusively for hauling purposes, the chain hitching device mentioned above is not part of the equipment, neither is it all needed. They are also provided with means to make the work of hitching and unhitching easy and convenient. A regular wagon box can be used with this trailer carrier and several of them can be used behind the tractor very conveniently and effectively.

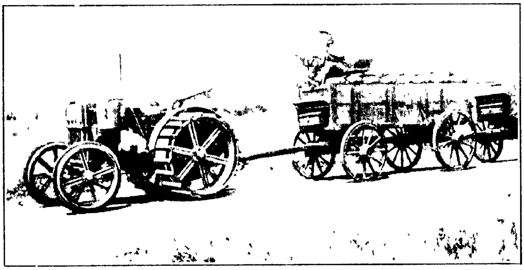


FIG 164.—Tractor with remote control used for hauling wagons

Operation.—About the only thing to bear in mind in the use of wagons with the tractor is frequent and thorough greasing of the wheels and skeins, and special attention to the hitching. When used on hard stone roads, the tires being iron, the wagons must be run at reasonable speeds Running wagons at four or four and one-half miles an hour over hard rough stone roads tends to peen the tires, which, in turn, expands them so they become loose and often fall off. Moderate speeds of from two to three and one-half miles an hour, and even four miles on a dirt or gravel road, will be found satisfactory.

Draft.—The following table, which represents tests made by the U. S. Department of Agriculture, shows the draft of wagons on different road surfaces, based on capacity in tons.

JOB	WIDTH OF TIRE	GROSS LOAD	AVERAGE DRAFT	MILES PER HOUR	HORSE POWER	DRAFT AT START	SURFACE
Dubuque, Iowa (a)	3″	5400	878.5	2.91	6.81	1020	Gravel ¾ loose on top
" " (b)	3″	5400	758.0	3.01	6.46	1090	do
" " (c)	3″	5400	780.0	3.10	6.46	930	do
" " (d)	3″	5400	825.0	3.00	6.60	950	do
" "	1⅝″	5400	428.5	2.91	3.33	770	Black dirt ¾ mud
Portland, Me (a)	3″	5500	842.5	2.32	5.21	1320	Gravel, dry
" " (b)	3″	5500	657.5	2.55	4.47	1070	" "
" " (c)	3″	5500	693.0	3.05	5.63	1130	" "
" " (d)	3″	5500	658.0	2.49	4.37	1240	" "
" " (e)	3″	5500	637.0	2.81	4.78	1200	" "
" " (f)	3″	5500	773.0	2.70	5.56	1120	" "
Ames, Iowa (4 horses)	3″	5200	665.5	3.09	5.48	940	Sand, clay, hard
Alexandria Va (4 horses)	2½″	6270	753.3	2.49	5.00	.	Soft mud and sand

CHAPTER XIII

ROAD MACHINERY *

Function.—This chapter is devoted to machinery for road work. Machinery for road maintenance only, for dragging and scraping the road, will be considered here Such machines as contractors' graders and levelers will not be considered as part of the farmers' work, because their use is largely restricted to the regular road-builder who makes road construction his specialty.

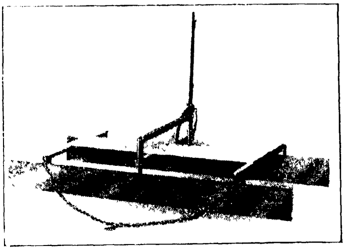


FIG 165 Single road-drag, 8-foot.

The purpose of the ordinary drag or road grader is to keep dirt or gravel roads in first class condition by covering the ruts and crowning An ordinary drag of the smaller sizes, while merely a load for two or three horses, may be made bigger and become a load for a small tractor Such a drag, while only 6 or 8 feet long, may be set at a good angle for tractor work and even two or three of them may be used in this manner. Its work will become more efficient and a greater area can be worked in a shorter period.

The regular type of grader—or scraper, as it is often termed—may have a 12 or 14-foot blade, and is used in places where the road must be built up and crowned. The ordinary drag serves more to keep a road in condition after the scraper has really built it up.

* See Farmers' Bulletin 95 "Good Roads for Farmers."
See Farmers' Bulletin 597, "The Road Drag"

Types, Sizes, and Rating.—Road drags are either home-made and of timber, or purchased from regular manufacturers who make them of metal. The former, if properly made, will serve the purpose, but need new steel blades from time to time as these become worn. The wood frame should last well, if cared for when not in use. The angle of a wooden home-made drag is generally constant, while a purchased steel drag is provided with levers to change this angle.

A grader is a special machine and it is usually the property of the township. There are hardly any differences between graders made by various manufacturers and there is, in

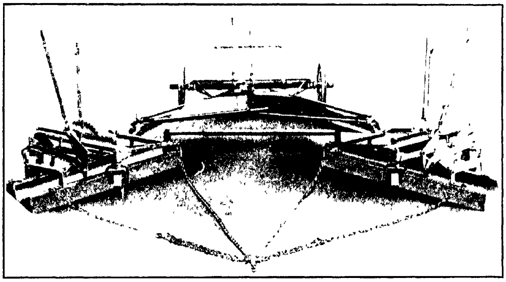


FIG. 166.—Triple road-drag.

general, but one type or kind of grader The length of the blade determines its size rating. A grader may be a 10-foot or 12-foot or 14-foot, indicating the total length of the grading blade. Some manufacturers build and sell a special machine for grading, but while it is a power grader in every instance, it may be used for other work too. Such a machine carries the blade right under its frame. The operator of the grader also operates the blade, making an excellent and economic road-working machine, and doing the road work at minimum expense and in the best possible manner.

Hitching.—The drags illustrated may be hitched directly to the tractor draw bar, with the chain or cable usually sup-

plied, which is about 5 feet from the drag, unless the draw bar is more than fifteen inches high. Where such is the case, an extra chain two or three feet in length should be used between the tractor draw bar and the hitching link of the drag. This lessens the tendency of the high draw bars on the tractor to lift the front of the drag and defeat the work for which it is intended.

Graders very often work pretty well over on the side, while the tractor will work nearer the crown of the road This side draft may be partially overcome by lengthening the hitch as shown in the illustration. Where two graders are used on a narrow road, one will counteract the other, thus eliminating

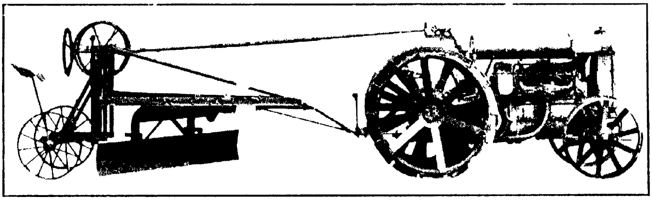


FIG. 167 Road scraper in combination with a tractor

the side draft on the tractor, but in either case it necessitates the use of a long hitch.

Operation.—The use of the drag is a comparatively simple job. The characteristics of the soil, together with its hardness, will determine whether some additional load must be carried on this machine to get results. To have it do effective work on a road of black land that is packed pretty hard may require heavy loading with sand bags or stones. Sand bags are more practical to use because they stay in place. When two of these drags are used, both should be loaded equally. They should also have independent hitches to the draw bar of the tractor and be set at the same angle

Where the conventional blade grader is used an extra man will be always required on the grader to operate the blade.

This man is enabled to guide the front wheels from his position on the machine so as to get the grader well over onto the side and bring the dirt from the ditch up to the crown of the road. It is a pretty good plan, in using a heavy grader, with say a 12- or 14-foot blade, to have a signal or a whistle of some sort with which to signal the tractor operator when it is necessary to stop immediately. This will make it unnecessary for the man on the tractor to be continually turning around to see how everything is progressing. It is not a bad idea to use

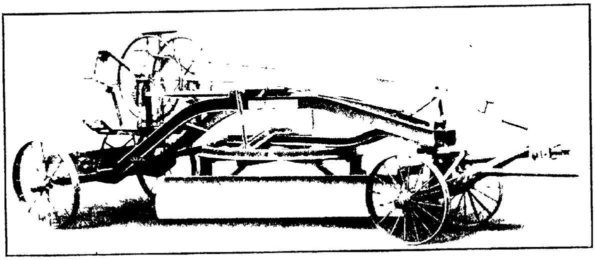


FIG. 168.—Independent road-scraper.

a break pin of some sort in the hitching clevis so that in case the blade of the grader goes too deep, or strikes a stump or an obstruction, this pin will shear and avoid doing serious damage to the grader.

It is best to work the graders very slowly. To use a grader at a speed of more than two miles an hour is folly and a slower speed is often more desirable. If the tractor has a low gear it should always be used in preference to intermediate or high gear. Better results will be secured and the machinery as a whole will stand up and perform much better, if a uniform rate of travel is maintained. It might be said that the draft of the grader is the maximum amount that the tractor can pull, since it is possible in any case to stall a tractor with the grader if the blade is set deep enough. It is better, in every case, to go over the road twice, taking a small amount each

time rather than to attempt to do too much in one operation. This not alone saves the grader, but is also much easier on the tractor, besides doing a better job on the road. Even three trips over the road, making the work of the outfit lighter and steadier as a whole, is preferable to trying to do too much at one time.

The care of the grader is important The various gears, cams, levers, and other devices used for angling the blade and altering the depth should all be kept well greased to make the work of the man on the grader as easy as possible. It is

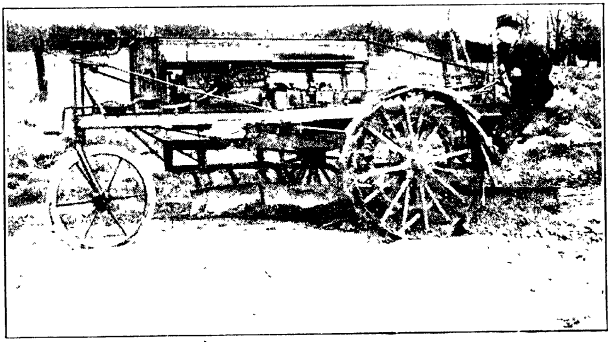


FIG. 169.—Road-drag, suspended under a motor cultivator.

also highly important that the truck wheels on these graders be kept well greased, because they have considerable work to do.

Capacity.—The amount of work a drag or grader will do in a day depends on the speed of the tractor. At 2 miles an hour a drag will go over and back on a mile stretch in 1 hour. With a triple drag this stretch could be covered in ½ hour.

Graders are usually worked slower but in any case only on one side of the road. The amount of work these road machines do is all a question of tractor travel and road condition.

Draft.—A log drag will show a draft of from 275 to 400 pounds. A steel drag well angled and loaded will have a draft of from 300 to 450 pounds. On very moist clay roads this may run up to even 650 pounds.

Graders will show a draft of from 1500 to 2500 pounds for regular road work. For working up ditches the draft

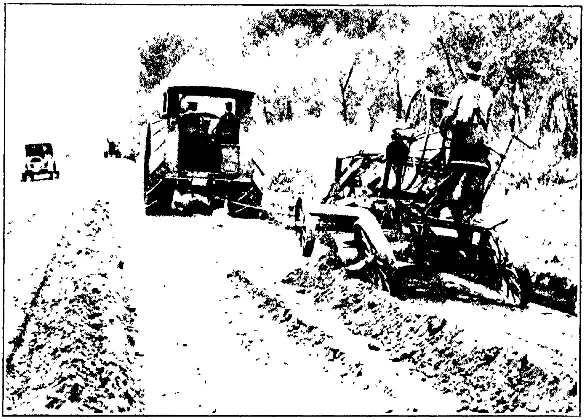


FIG. 170.—Heavy-duty road-grader and tractor (Note lengthened hitch.)

may be as much as 4000 or 5000 pounds. Draft is a very big problem, and as in plowing, the effect of the hitch and the effect of the soil or road conditions has a decided influence on the draft of the grader Perhaps the biggest factor in draft is due to the judgment of the man operating the blade of the grader. He can set the blade pretty well down—in fact, so far down that it will actually stall almost any tractor.

CHAPTER XIV

MISCELLANEOUS MACHINES

Corn Pickers

Function.—This machine picks the ears of corn from the standing stalk in the field, removes the husks, and by means of an elevator delivers the ears to a wagon box which may be drawn alongside the corn picker. The husks fall through to the ground. To accomplish this the machine embodies snapping rolls which remove the ears from the stalks, and husking rolls which, in their turn, remove the husks from the ears. It should handle the work of picking corn from fields of various yields and in various conditions. To expect to pick ears from down corn would be unreasonable, and it is also impossible to pick all small ears and "nubbins."

Hitching.—The corn picker is provided with a fore-carriage which should always be used when hitching behind a tractor. So much of the mechanism is carried on this fore-carriage or tongue truck attachment that to dispense with it is impractical. It is also important that the operator of the corn picker ride on the machine so that he can at any time see if it is performing properly When hitching a machine of this sort to the tractor care should be used to see that room is allowed for turning. A stub tongue is the best means of hitching to the tractor. Chains should not be used, because when working on a hill and going down grade it may be very inadvisable to have the corn picker travel ahead more rapidly than the tractor. A stub tongue also permits of easy turning and of better control. It is desirable to use a wood break pin in the clevis.

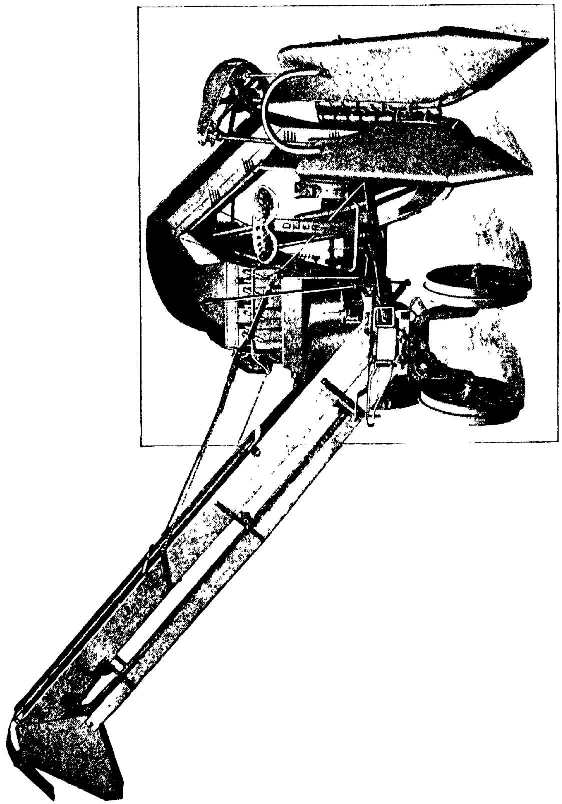


FIG. 171.—Corn picker

Field Operation.—As the picker is used for corn it has a heavy duty to perform and must necessarily be very well lubricated. The drive wheels and the drive chains, together with the countershaft and cross-shaft, should receive continued attention from the operator. The snapping rolls at both ends, and particularly the lower bearing, need special care. The bearings should be oiled very often. The husking rolls, too, require frequent oiling.

FIG. 172.—Corn picker, with ear-wagon being drawn by single tractor.

It is well not to forget to oil the elevator that conveys the ears to the wagon box, and attention may appropriately be called to the bearings at the outer end of this elevator which can be reached only from the wagon box into which the ears are delivered. The bull wheels and the fore-carriage wheels, and the gears and the sliding clutches should also be oiled very often. It is essential that light oil be used, because most of this work is done late in the season when the temperatures are unusually low and the average heavy oil gets too thick to run into the small oil holes so that it cannot oil the bearing

properly. A high grade light oil that will flow freely from the spout of an oil can in cold weather is desirable.

The operator of the corn picker is enabled, by the aid of a lever, to set the machine either down or up at the front end as he chooses, so as to get all the corn and to handle it in the most satisfactory manner Some care should be used to see that the nose is not run so low that it will continually dig into the hills and become a factor in the draft of the machine The explanation of husking rolls in the chapter on the Husker-

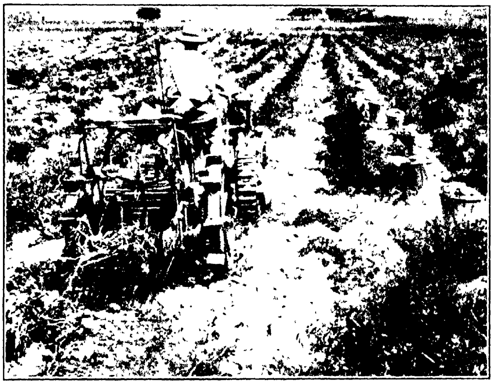


FIG. 173 - Potato digger in field.

Shredder will apply equally well here, that in the same chapter, on snapping rolls, while not applying exactly to this machine, has a decided effect on the performance of these parts. This machine should be used at a moderate rate of travel, for when used with a tractor, if the rate of travel is too fast, poor and unsatisfactory work will be the result. A speed of from 2 to $2\frac{1}{4}$ miles an hour is desirable.

Capacity.—Used in combination with the tractor, this machine is able to pick and husk the corn from four to six acres a day at a speed of two and one-quarter miles an hour when

corn is planted forty-two inches apart. Where conditions are such that the land is level and the corn all standing, as many as eight acres may be covered in a day. The use of the tractor at increased speeds would materially increase the capacity, but it is not desirable to run the picker any faster than two and one-half miles per hour. The danger of running too fast lies in the fact that much of the corn would be uprooted and the result is very poor picking, which means waste. This is not economic farm work even though a large acreage may be covered in a day.

Draft.—The power required to pull a corn picker depends on whether or not an auxiliary engine is used in combination with the machine itself. Where the operating power is taken from the bull wheels, this machine will, on the average, require about 1150 pounds to draw it. In extreme cases this figure may be as high as 1800 pounds. Where the mechanism is run with an independent engine, 850 pounds will, on an average, be sufficient to handle the machine running to capacity, and in cases where sandy soil predominates, this figure will often be more than 1000 pounds. There are many factors entering into the question of draft. The greatest of these is the degree of lubrication and the condition of the machine as a whole. The yield of the corn is another factor that materially affects the draft, but it is not as big a factor as the condition of the machine itself.

Potato Diggers

Function.—The potato digger harvests potatoes by digging them out of the ground. It should work equally well in heavy and light soil or in any ground that is very dry or very damp. It should dig the potatoes and separate them from the dirt, which forms a part of the mass that is being elevated.

Types and Sizes.—All diggers have much the same characteristics, and they work in practically the same manner. The mechanical differences in these various types are slight. The

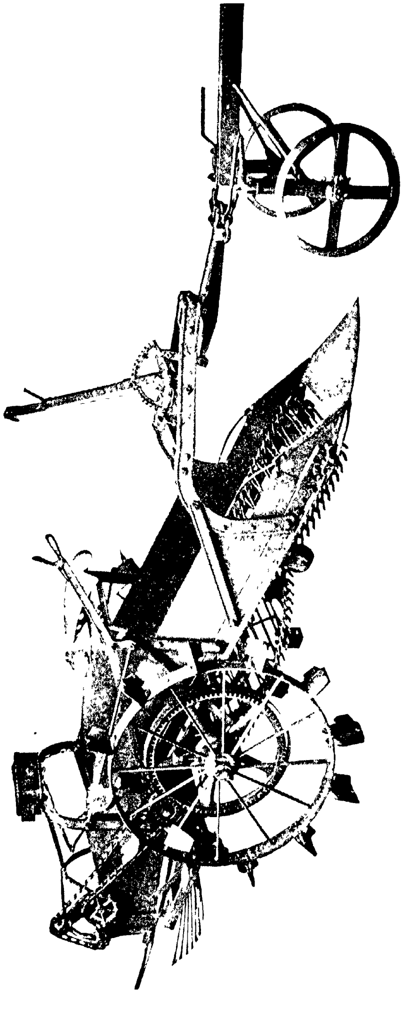


FIG. 174.—Potato digger.

sizes vary from about thirty inches to forty inches in width, referring to the distance between the sides, or, in other words, the width of the rake which elevates and separates the potato from the dirt. Special tractor diggers to withstand this heavy work are now on the market which are a means to better and more rapid work of digging potatoes.

Hitching.—To hitch a potato digger to a tractor is comparatively simple. The tongue truck carrying the front end of the machine is a part of it and should always be used. A stub tongue with a clevis arrangement hitched to the tractor should also be used. If desirable, a chain with a short length, one or two feet, may be used. The difference in height between the draw bar of the different tractors has little or no effect on the work of the digger, unless this difference is so great that it causes trouble. But the digger should be hitched in the center, as this will prove to be the simplest method.

Field Operation.—The power to operate the rake, which elevates the potatoes, together with the ground, is derived from the wheels, which are provided with long lugs to give it the necessary traction. This elevator is frequently termed an "agitator," and its action is procured by means of elliptical sprockets which agitate the elevator rake to separate the dirt from the potatoes. As the digger works in the ground particular attention to oiling is essential. The various sprockets and shafts upon which the agitator elevator runs requires considerable care, particularly those at the lower end; likewise, the main axle, together with the countershaft and the gears between them.

The operator should set the machine into the ground just deep enough to do the work of digging without lifting any more dirt than is absolutely necessary, for lifting dirt absorbs an unnecessary amount of power and overloads the machine. The potatoes are usually deposited on the ground at the rear of the machine, after passing over a forked shaking device which further agitates them, and which also delivers them

pretty well to one side of the hill, making room for the tractor to go down the next hill which is to be dug

Attachments.—Various attachments for this machine may be procured for different purposes. One of the most common of them is a separate engine which is usually set above the digger and which furnishes the power to operate the rake or agitator instead of taking the power through the wheels. The tractor furnishes the power necessary to draw the machine itself in the field. When an engine is used with this kind of machine it must be mounted according to the directions given by the manufacturer. All the necessary attaching irons are furnished, and when directions are closely followed, prove a very satisfactory attachment for the diggers. In a heavy yield of potatoes, it will be possible to travel very slowly over the ground and do a thorough job of digging and separating the potatoes from dirt and vines This is because the elevators run independently of the rate of travel. Elevators for delivering these potatoes forward to the side may also be procured. Other attachments such as vine trimmers and shakers and stone traps, rolling coulters, etc., can be procured when it is necessary to use them Road rings, which are tires to fit over these high lugs on the wheels, should also be procured so that the machine can be moved over the road or from field to field.

Draft.—The draft of the potato digger is very heavy and, therefore, the tractor affords a particularly handy and economic means of doing the work in the shortest possible time. The soil has a decided influence on the draft, but since most potatoes are grown in soil of a similar character, the draft in various localities will be nearly the same. It has been found that the difference in draft in machines of this sort varies from 650 to 940 pounds. Tests which have been made reveal an average of 734 pounds for each machine. This average refers to machines receiving their power from the traction wheels. Where an independent engine is used, draft is reduced only about 10%, or about 660 pounds, owing

to the fact that the engine adds some weight and in a measure offsets the results obtained, but even then it can be seen that the reduction is worth while.

Capacity.—The capacity of the potato digger is about 6 or 7 acres per day. This figure may seem a trifle low, but potatoes should be carefully handled in the harvest. A rapid rate of travel may enable the farmer to cover more ground, but at the expense of not digging the potatoes thoroughly. A rapid

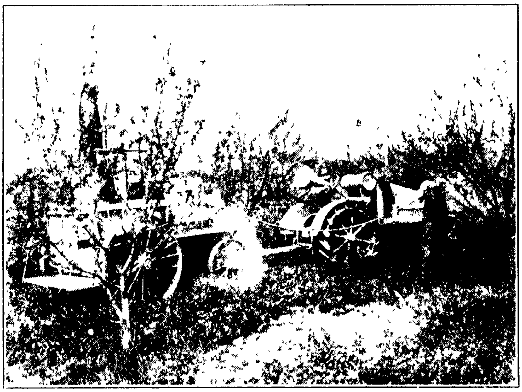


FIG. 175. Sprayer tractor drawer.

gait might also injure a great many, which would reduce their grade.

STALK CUTTERS

Function.—The stalk cutter is used primarily for cutting cornstalks when the corn has either been picked or "hogged down," so that they may be plowed under in the easiest manner and enable the farmer to prepare a seed bed.

Types and Sizes.—Stalk cutters are very much alike. All are built on about the same principle and have a series of knives that cut the stalks on the ground. Some of them

are of a single-row type and others of the double-row type. In either case, their construction is identical. They may have either a single cylinder or double cylinder.

Hitching.—This machine may be hitched very simply. Since it has no side draft, it may be hitched by a stub tongue to the tractor draw bar by means of a clevis.

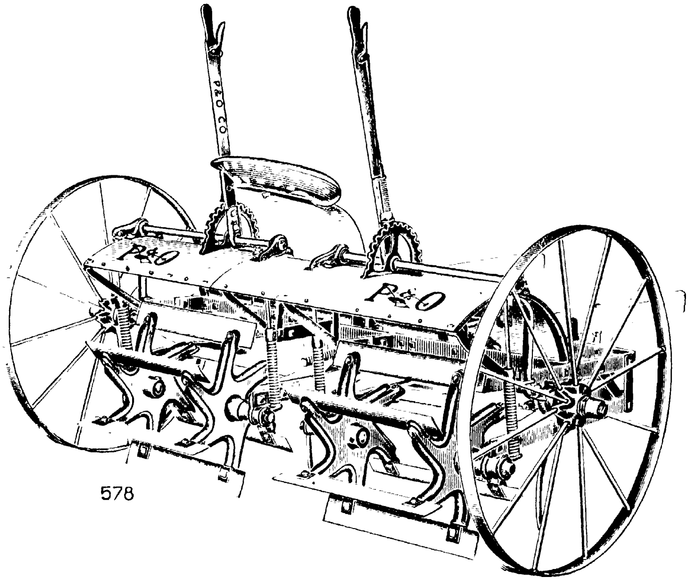


FIG. 176.—Double-row stalk-cutter

Field Operation.—The knives which do the work should be kept sharpened, for unless they are sharp they will not cut the stalks and, consequently, will in a measure defeat the work of the machine. Pressure on the cutting cylinder to which the knives are secured can be altered to suit the conditions. The lever for setting them is conveniently located. In no case, however, should this alteration be any greater than

is absolutely required to do the cutting. It will be found that this pressure is against a spring on each side of the cylinder which allows some leeway in case obstructions are encountered. The springs will then compress and avoid damaging the machine The usual attention in the way of oiling must be given to the wheels of the machine itself. The cylinder shaft boxes, which are subjected to the heaviest work, need care in lubricating. In very badly tangled corn, the cylinder may tend to wind, this happens when stalks get between the arms of the cylinder itself. Where this occurs, they should be cleaned out The operator should not attempt to run with a load of trash in the cutting cylinder.

Draft.—The draft of the stalk cutter is from 350 to 400 pounds. This is all that will be required to pull a double machine under the most severe conditions, when it must be working free. If the cylinder is wound up with trash and stalks, the draft may be twice as great and run up to 700 or 800 pounds without accomplishing any more work.

Capacity.—The capacity of a single-row stalk cutter is from 7 to 8 acres a day. The double row machine will do twice as much, or from 14 to 18 acres a day. This accounts for a rate of travel of about 2 to 2½ miles per hour. As this rate of travel is increased, then, so will the capacity be increased.

CHAPTER XV

TESTING MACHINERY FOR DRAFT

All machinery that is drawn by the tractor, or by any other drawing device, is referred to as having "draft," which is usually expressed in pounds. The machine that does the drawing, whether it be a tractor or a horse, or even a locomotive, exerts energy, which is termed "pull." It is important to get this distinction between draft and pull clearly in mind, because it is referred to throughout this book. Various me-

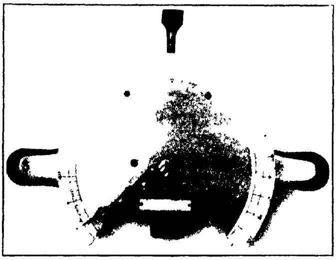


FIG. 177-A.—Indicating spring draw-bar dynamometer.

chanisms are used to record the draft of machinery or the pull of tractors. These devices or instruments are termed "Draw-bar Dynamometers." The simplest form is a spring dynamometer with a dial and a hand which record the number of pounds required either to stretch or to compress the spring, as the case may be. The dynamometer shows only the pounds exerted by the machine that is pulling the load.

There are other machines on the market which have a clock mechanism as a part and this mechanism records time as well

as the pull in pounds On such machines, as illustrated, it will be seen that the number of pounds pulled are not only shown on a scale, but that they are actually recorded on a strip of paper The record on the paper indicates the pull in pounds and the time which has elapsed Still other machines of this type do all this and, in addition, record the distance over which the pull is made. In other words, the three factors of pull in pounds, time elapsed, and distance traveled are recorded on a chart, enabling anyone to calculate the horse power, which, of course, is based on lifting 33,000 *pounds one foot in one minute.*

The machine illustrated (Figure 178) was used to make all the tests from which the data given in this book was obtained.

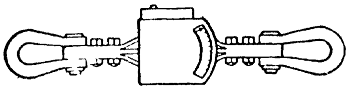


FIG. 177-B.—Recording spring draw-bar dynamometer.

The dynamometer is termed a "hydrostatic" dynamometer because it has a fluid, usually oil, in a rubber bag between a piston and a head on which the pressure acts. Pressure on the fluid is carried through a small copper tube to the gage, where, by means of a bourdon spring similar to those used in steam gages, the pressure is actually recorded with ink on the paper dial. This gage contains clock works which record the time on the paper dial also. The dial is moved by the action of the trailer wheel attached to the tractor, and by means of a speedometer cable it moves the paper dial or chart. Calculations are made by getting an average reading from this chart, which represents the average draw bar pull or average draft.

The average horse power is determined by the following formula:

$$\text{Average Draw bar H.P.} = \frac{\text{Average draw bar pull in pounds} \times \text{distance traveled in feet}}{\text{Time elapsed in minutes} \times 33{,}000}$$

The illustration shows how this dynamometer is coupled between a tractor and a plow, and how the records are made. Tractors are made with a limited amount of draw bar pull, which varies according to the size and weight of the tractor, and also the soil upon which it works. Plows, too, have a certain amount of draft which varies according to the type of plow, the speed at which it travels, the adjustments of the plow, and the various soils in which the plow works.

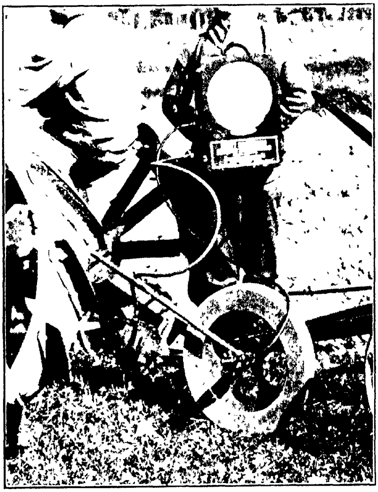


FIG. 178.—Recording hydrostatic draw bar dynamometer.

It is not possible for every tractor operator to make tests of his tractor and implement, and it is quite unnecessary. Each manufacturer furnishes for use with the tractor implements that are based on field operation and tests made by the aid of a dynamometer. The information given under each heading, with reference to the draft of machinery, will serve for comparison of the various machines used in combination with the tractor. Manufacturers, therefore, are enabled to recommend for use with their tractors drawn machinery that will give satisfactory results.

The dynamometer enables them to make tests in the field under varying conditions of soils to know exactly what combination of tractor and drawn implements go best together. They are also able by the aid of this dynamometer to get the

draft of machines of various types and of machines equipped with anti-friction bearing as compared with those with plain bearings. They are also enabled to find out at what speeds, or rates of travel over the ground, the various machines pull the

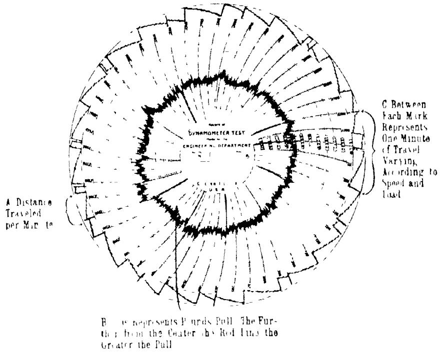


FIG. 179.—Record chart made with hydrostatic draw bar dynamometer.

lightest, consistent with the work they perform These instruments are of value to all concerned since by their aid, information of this sort becomes available which enables the farmer to get better tractor and implement performance.

PART II

BELT DRIVEN MACHINERY

CHAPTER XVI

BELT SPEEDS

The subject of belt speeds refers particularly to those belts which are used for transmitting the power from the tractor to the belt-driven machines usually referred to as the "Main Drive Belt." The term "Belt Speed" refers to the travel of the main drive belt in *feet per minute*, and is usually indicated by the letters "F.P.M." Revolutions per minute are indicated by "R.P.M."

Through the activities of the American Society of Agricultural Engineers, and the Automotive Engineers, working together with the manufacturers of tractors and belt-driven machinery, standards have been proposed for use on all belt driven farm equipment and tractors. By this is meant that a certain number of feet travel has been chosen, representing the most common practice on farm machinery. These speeds are 2600, 3000, 3250 and 3500, and they cover the entire range of farm machines and tractors. While it would be most satisfactory to have but one standard belt speed—and it is the aim that ultimately such will be the case—present conditions will not permit it, and the nearest approach is a start which is represented by the figures given above.

Figuring Speeds.—It is comparatively easy to compute the belt speed in F.P.M., on any machine by *multiplying the revolutions of the drive pulley on the tractor by its diameter in inches, multiplied by 3 1416 and dividing this result by twelve (which represents the inches in a foot); the answer will be the travel at the circumference of the pulley in feet per minute. This, therefore, represents the belt speed in F.P.M., providing there is no slippage, since it travels over this circumference of the pulley.*

Care should be taken in measuring the diameter of the pulley to get the largest diameter, which is always in the center or crown, as it is commonly called, on the drive pulley. Nearly all belt-driven machines have a speed which the manufacturer has found correct, to get the best results from these machines. Tractors, too, are run at a speed at which they perform best and at which they run most economically. It is very essential that the tractor be run at its correct speed, and it is equally, if not more essential and important that belt-driven machines be run at their correct speed. In most cases the proper speed at which the belt-driven machine should run is printed or stenciled on the side of the machine, usually near the main drive pulley.

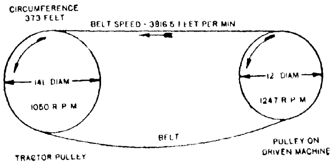


Fig. 180 - Pulley diagram.

The speed of the tractor-drive pulley given or known, and its diameter also known, to find the speed of the driven pulley —that is, the pulley on the belt-driven machine—proceed as follows: *Multiply the diameter, in inches, of the drive pulley on the tractor by the speed at which it revolves, and divide the result by the diameter of the main drive pulley on the belt-driven machine. The result will be the speed at which this main drive pulley on the belt-driven machine runs.*

Knowing the speed at which the belt-driven machine is to run, together with the engine speed and the diameter of its pulley, to find what size pulley should be used on the belt-driven machine, proceed as follows. *Multiply the diameter, in inches, of the main drive pulley on the tractor by its speed, and divide the result by the speed at which the main drive pulley of the belt-driven machine should run. The result will be the diameter in inches of the pulley that should be used on the belt-driven machine.*

Pulleys are usually made in diameters ranging in quarters of an inch. This is close enough for all practical purposes.

Speed Indicators.—Their purpose is to record or count the revolutions of a shaft or pulley. These speed indicators are also frequently called "Revolution Counters." This is a small, inexpensive instrument that may be purchased anywhere from $1 upward. To use them, it is merely necessary to hold the center, or revolving part, of the indicator against the center of the revolving shaft for a given period of time, which usually is one minute. The revolutions during this period will, therefore, be recorded on the dial of the instrument. It may be held on the shaft one-half minute and the figure on the dial multiplied by two to give the revolutions in one minute which will be the R.P.M. of this particular shaft and its pulleys.

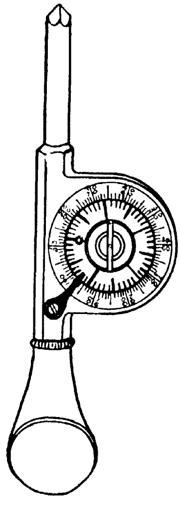


FIG. 181.—Revolution counter.

A speed indicator or tachometer, as it is correctly termed, will show the speed of the revolving shaft instantly.

Frequently shafts will be found that do not have a center mark in them, and in such cases it will be necessary to use a center punch and get a center in the shaft so that it will drive the revolution counter without slipping. Care should be used to place it against the shaft hard enough that it will not slip but give accurate results.

It is a good plan, after the machine is in operation, in actually doing the work of threshing, shredding, shelling, sawing, or whatever else is to be done, to put the speed indicator on these belt-driven machines to make sure that they are actually running at their proper speed while they are doing their work. Very often a machine will run at its proper speed when it is

running empty, but fall considerably below this speed when under load. This decrease in speed should, therefore, be checked and a speed indicator or revolution counter is the safest and surest means for doing this

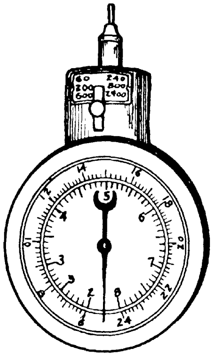


FIG 182—Tachometer.

It is very important that the proper combination of pulleys for the tractor and belt-driven machine be so used that the speed of the belt-driven machine is correct.

Manufacturers of threshers, shredders, silo fillers and other belt-driven machines find that fully 30 per cent of all complaints from the field may be traced to faulty and incorrect speeds. This indicates the importance of considerable attention to the subject by those who operate belt-driven farm equipment of all kinds.

CHAPTER XVII

LINING-UP AND SETTING

It is important to belt properly the machinery that the tractor drives. There is a correct method of driving these machines: so that both the tractor and the belt-driven machine are correctly and properly set with reference to each other. The drive shafts and the pulleys, which are mounted on them, should be parallel.

Some of the belt-driven machines are provided with what is commonly termed a "Belt Guide." The purpose of a belt guide is to keep the belt running in the center of the main-drive pulley. In many instances the tractor operator cares very little whether the machines are properly set, assuming that the belt guide will do its work irrespective of where he sets the tractor. He may be right to some extent, but the result will be that the belt will be worn out along the edge in a comparatively short time. This is due to its rubbing on the belt guide. If a canvas or rubber belt is used, the result is serious, because the belts are made up in plies that fold on the edges, and when these edges are worn the belt weakens materially and deteriorates rapidly.

A main drive belt will run in such cases even if a foot or more out of line, but this means end thrust on bearings and therefore must be guarded against. It also stretches one side and the result is a belt that will always cause trouble and delays.

To be able to line-up and set in a short time without much needless work, and to set properly so that the belt will run and transmit its power evenly, is a qualification of which any tractor operator may justly be proud. Some degree of cau-

tion should be used in backing into the belt in order not to get the belt too tight, which causes unnecessary loads on the bearings of both the tractor and the belt-driven machine and means that more power will be required to operate the outfit. Some judgment must, therefore, be used in doing this. It is, of course, necessary to back into the belt sufficiently tight so that it will not drag on the ground or on any part of either machine; this would wear it out rapidly. It should be just

FIG. 183.—A perfect "line-up."

tight enough to transmit the power properly from the tractor to the belt-driven machine without belt slippage.

It is important that the direction of rotation of the belt-driven machine be definitely certain. If a machine is properly lined, the belt may be put on either straight or crossed. It would be folly to get a belt on straight that should be crossed, or vice versa. Since the direction of rotation of the main-drive pulley on tractors is not the same on all makes, this matter should be very carefully looked after to make sure that the

belt-driven machine runs properly. On some tractors the drive pulley is set crosswise of the machine, and in such cases particular care must be exercised to get the tractor run into its proper place, so that the belt when put on will be tight. It may even be necessary to use a stake and a jack screw to push the tractor into the belt tight enough to transmit its power.

The illustration shows a tractor of this sort belted to an ensilage cutter with the wheels also set crosswise from the

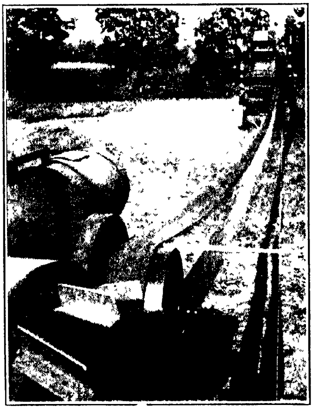


FIG. 184.—Tractor set about 18 inches out of line. This runs a main drive belt by stretching one side and wears it out by rubbing on the belt guide.

drive pulley. It would be impossible in this case, or in any case of an ensilage cutter that sets tight up against the silo, to move the machine, and the jack screws affords the only means of keeping the tension of the main belt where it should be. On such machines as threshers, shellers, and machines mounted on trucks—where the driven machine itself may be backed up into the belt—a tractor of this sort may be permanently staked.

On windy days, if the belt shows a tendency to run off or

persists in running on one side of either of the pulleys, it may be necessary to reset, because this too sets up considerable end thrust. This running off should not be permitted. The belt should always run on the center of the pulleys. Sometimes the front end of a conventional type of tractor may be jacked over into the wind to keep the belt running on the center of the tractor drive pulley. It may even be necessary at times to jack over the front end of the belt-driven machine to keep the belt running properly on its pulley. In no case should a stake ever be driven into the ground to guide

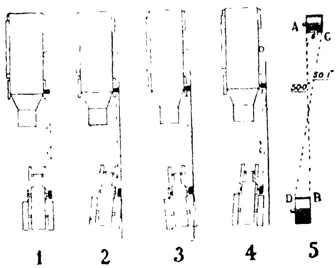


FIG. 185. 1. A perfect setting. 2 and 3, Tractor in line but at incorrect angle. 4, Tractor out of line. 5, Showing stretching of belt one inch because of improper alignment.

the main belt either onto the pulley of the driven machine or the drive pulley of the tractor. The result is the same if a guide were being used to keep an improperly aligned belt running on a pulley.

To get the best results, considerable practice may be necessary to line up properly and set the tractor and belt-driven machine combination. It will be worth while, however, to practice doing this because the results in the way of performance will more than pay in the long run.

On tractors where the main drive belt after being belted to the driven machine rubs on the front axle or any ooher part of the tractor, it is important that a roller or pulley idler of some

sort be placed under the belt in this place to keep it from rubbing. It is not at all impossible to spoil a brand new belt completely in a few hours by running it in this manner, and, therefore, particular attention in this respect is required. Such rubbing would be even worse than having the belt so loose that it drags on the ground

After the belt-driven machine is properly set, it should be blocked with a piece of wood Where considerable work is done in a season, it is a good plan to have a triangular piece of timber, measuring some eight or ten inches on a side, just for this purpose, to be placed under the rear wheels of a belt-driven machine. This should always be put under the wheel before backing the tractor into the belt, so that the tension of the belt does not pull the machine along and get it out of line. Also, pulling the belt-driven machine by the belt is very apt to spring the shafts. After the tractor is backed into the belt it also should be blocked with a large triangular piece of wood, or even a round piece eight or ten inches in diameter, which should be used under the drive wheel on the side where the belt pulley is located.

After the machine has been thus set, the belt-driven machine and the tractor, too, should be set level. It is good practice to select a place nearly level for the setting originally, so that no digging, or at least very little, will be necessary afterwards to level either or both of the machines. Leveling both the machines crosswise is necessary and can best be done by digging under one of the rear wheels. Digging under the high wheel at the rear would be the quickest means of setting the machine level. In most cases, it matters very little whether the front or rear of the machine is set either a little high or low. Setting level is more satisfactory. In some cases, however—par-

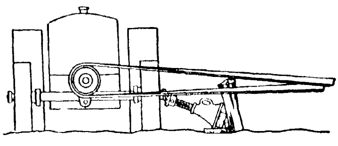


FIG. 186.—Using a screw jack to set the tractor.

ticularly in threshing and husking machines—it may be necessary to either raise or lower the rear end of the machine for cleaning reasons.

In setting in the barnyard, as would be the case during shredding or silo-filling time, it is important that the location of the tractor be well selected so that the wagons hauling the material to the machine will have plenty of room to drive in and drive out. These details should all be considered to facilitate fast work. When doing belt work around barnyards, it is also important to consider the low and soft spots, such as an old stack bottom which, although dry on the top, would mire a tractor that got into it so badly that it might require a half day or even more to get it out.

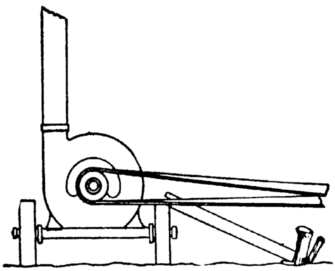


FIG. 187.—A silo filler held in position to keep proper tension on the belt.

Another important point is that but one person at the belt-driven machine should be responsible for signaling the operator of the tractor to start or stop. If too many persons, or even several, attempt to signal, there is danger that some one will sooner or later become seriously injured. One man will feel his responsibility more keenly, and he is more apt to keep his eye on the machine and see that everything is clear before he signals for a start.

On such small units as are used for individual work, particularly where the farmer does his own work, it is hardly necessary to keep a man or even a boy continually at the tractor. A very good scheme has been worked out by some farmers which has proven practical. This is as follows: A rope is tied on the lever or other part that disengages the clutch of the tractor. The rope is then run back through a sheave pulley, securely fastened to a stake, which may be driven into

the ground, and then forward to a convenient place at the front end of the belt-driven machine. This arrangement applies to machines where the lever that disengages the clutch must be pulled to the rear. On machines where the lever would pull forward, the rope would run directly to the belt-driven machine. If disengaging the clutch should mean pulling it to the side, the stake with the sheave pulley must be set on the side. In any case, it should be convenient to disengage the clutch in a hurry when something goes wrong with the machine for any reason whatever. Even a means of throwing off the electric switch will cause the tractor to stop quickly. The distance between the tractor and the belt-driven machine depends on the length of belt used and sometimes necessitates too long a run to get there quickly enough to stop the rig in the shortest possible time, and for that reason the scheme just outlined may prove satisfactory and convenient.

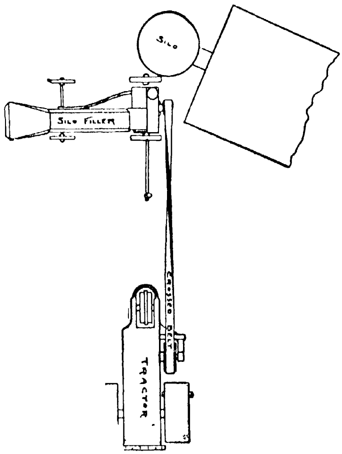


FIG. 188.—The tractor backed into the belt.

On custom rigs of all sorts, it is a good practice to keep a man at the tractor. In any case, the use of a man here is dependent upon the size of the outfit, and this should be worked out to suit the conditions. The tractor operator in any case should continually keep his "ears peeled" for sounds and noises which may reveal trouble. A sense of hearing, if keenly developed, will often prove more valuable than eyesight, because unusual noises can be heard, and trouble located a great deal more quickly that way, than by seeing the difficulties. In

fact, knocks or pounds that would not reveal anything at all to the eye would, to a well trained ear, instantly reveal a loose part or one that was not working smoothly on the belt-driven machine.

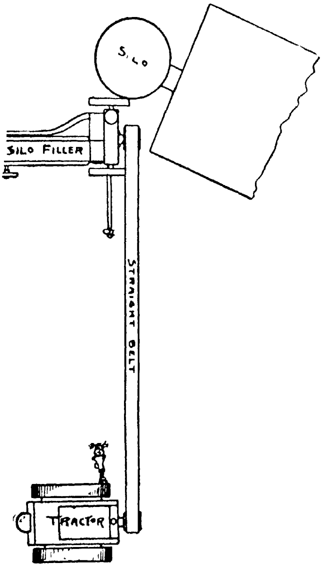


FIG. 189.—Tractor jacked into the belt and silo filler permanently staked in place.

A hot bearing on the belt-driven machine would act like a brake and while it would not be heard, it would consume so much more power that the tractor engine would begin to labor as with an overload, and this, to a well-developed sense of hearing, would reveal trouble instantly. Therefore, if the tractor operator works around the belt-driven machine he will be able to detect trouble if he trains himself particularly well to listen to unusual noises.

To get the maximum performance out of this combination of belt-driven machine and tractor is the purpose of the power farmer. Therefore, to get the best combination it is necessary to have it properly belted and properly set. After two or three days' running, sometimes resetting two and three times a day is necessary, and a little extra care and time taken in doing this usually will more than pay in the long run. It, therefore, needs a good deal of attention and is an important part in the performance of this outfit.

CHAPTER XVIII

THRESHING MACHINERY

Threshing machines are very often termed "Grain Separators."

Function.—Threshing machinery separates the grain from the straw and chaff, cleans it thoroughly, and puts it in shape for the market. A threshing machine should handle all small grain, and with special attachments it will handle grass seeds, peas, beans, peanuts, etc. It should get all the grain out of the straw and remove all foul seeds, dirt, and other foreign material. Attachments are provided which alter the relative speeds of parts and bring about other necessary changes for doing the various kinds of threshing successfully.

Size and Rating.—Threshing machinery is rated according to size as 20 x 36, 22 x 40, 26 x 46, etc. These figures represent inches of width at the front or feeding end, at the cylinder itself, and the width at the rear at the straw racks, grain pan, shoe, and sieves. The figures are inside dimensions and are nominal. The actual figures of the machine may vary slightly, perhaps one-half inch or so, either way, from the rated size.

The rating of capacity is usually given in bushels of wheat or oats that the machine should successfully handle per hour or per day. This, however, is very vague, since the yields of grain vary and this has an influence on the capacity because it would be much easier to thresh 1000 bushels from straw if the yield was 60 bushels per acre than it would if the yield were only 20 bushels an acre. This rating, therefore, should be considered with the yield in mind.

More headed wheat could be threshed in an hour than if it were on long straw.

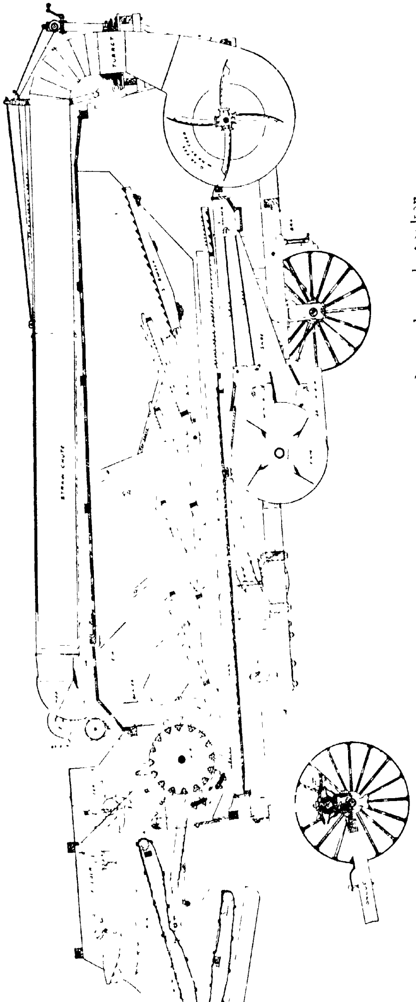


FIG. 190.—Sectional view of grain thresher, with feeder and wind stacker.

Field Operation.*—*The cylinder* is the "business end" of the threshing machine and does the actual threshing. By the aid of the spikes or teeth it pulls the straw and grain through between the spikes or teeth of a concave located beneath it, where the heads or grain kernels are removed from the straw. This is the threshing process. An open slatted grate work underneath and toward the rear allows this threshed grain to fall through to the conveyor or grain pan.

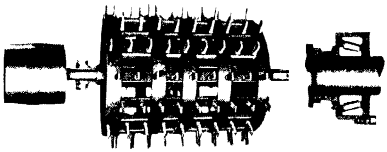


FIG. 192 Thresher cylinder. Enlarged view of anti-friction bearing box.

Long years of experience have determined that the speed of this cylinder at the very end of the teeth must be maintained very nearly constant, and at about 6200 F.P.M., regardless of cylinder diameter. Cylinder diameters vary, and small machines use what is called a 9-bar, medium size machine, a 12 bar, and the large machines use 16, 18, or 20 bar cylinders. The relative speeds vary since the diameters vary from about eighteen inches to thirty-one inches. Therefore, to get the constant periphery, speed or velocity in F.P.M., the speeds vary from 1300 R.P.M. to 750 R.P.M. approximately. Threshing rice, peas, beans and peanuts calls for reduced cylinder speed, but the balance of the thresher and its attachments must run at their normal speed. These reduced cylinder speeds vary from 250 to 650 R.P.M. approximately. Threshing grain is by far the biggest part of the threshing work. It then follows that the regular speeds are most common.

It is of utmost importance that the speeds of the threshing machine be uniformly maintained. To have variable speeds means wastage of grain and poor cleaning. This should be watched very carefully. One of the best ways is to use the speed indicator or revolution counter diligently.

* See Farmers' Bulletin 991, "The Efficient Operation of Threshing Machines."

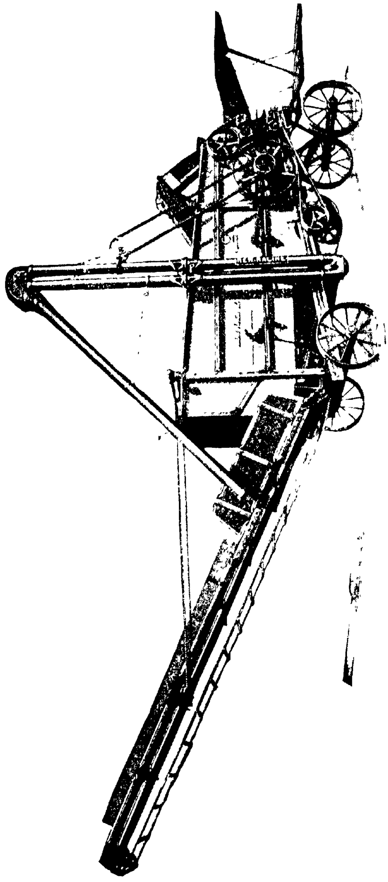


FIG. 191.—A thresher with hand-feeding attachment, plain stacker, and high loader.

The number of teeth in the cylinder varies with the locality where the machine is to be used. For threshing "Turkey-red" or "Barletta," a full spiked cylinder is desirable. This is due to the difficulty of threshing this grain from the straw. For blue stem and fife varieties the regularly spiked cylinder with considerably fewer teeth will do satisfactory work. The spacing of these teeth varies with their thickness. The clearance between the teeth is the governing factor. It is essential that this be just right so that the kernels will not be cracked by being crushed between the teeth of the cylinder and the teeth of the concave. For threshing rice, a slightly greater space is needed, due to the fact that rice grains are large. Peas, beans, and peanuts require still greater clearance. In fact, the clearance must vary with size of the grains. (See paragraph on this subject.) The spacing for wheat is very close to $^5/_{32}$ of an inch.

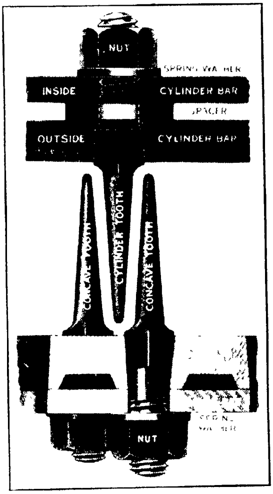


FIG. 193. Cylinder teeth must pass exactly midway between the concave teeth.

One of the essentials in the successful operation of a thresher is correct cylinder setting. By that is meant that these spaces are equal on both sides of the teeth. In other words, the cylinder teeth must travel exactly midway between each set of concave teeth. The distance must be exact and be maintained at all times. The cylinder boxes or the concaves may be moved so that this is absolutely correct. On most modern machines, means are provided for setting the concaves as a unit either one way or the other. This will often be a means of getting exact adjustment. The boxes on the cylinder offer means of adjustment too. When this is done, great care

should be exercised to see that they are not set so close to the cylinder head as to cause danger of heating. A scant sixty-fourth of an inch is enough end clearance. It will be remembered that the smallest amount of clearance here consistent with good work is best.

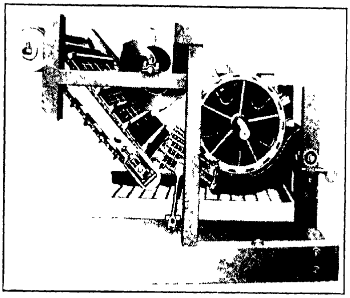


FIG. 194.—A cylinder, beater, and separating chain-rake.

The concaves beneath the cylinder are in sections with holes for two or three rows of teeth each. It follows that different concave arrangements are possible. The most common arrangement for small grain threshing is one in the front with two rows, then one blank without teeth, then another full concave. Most often an open concave, called a concave grate, is used in the center instead of the concave without teeth. This is preferable because it has about three

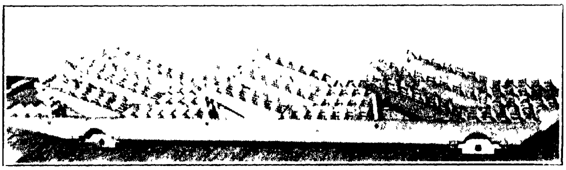


FIG. 195.—Straw racks of a modern thresher.

times as much open area through which the threshed grain may fall down to the grain pan.

When grain is very dry, it is often found that the cylinder will seem to lack capacity and in such cases it may be made to take more, by placing a blank concave in the front. Even a concave with the first row of teeth removed may do. This is

often referred to by regular threshermen as "giving the cylinder 'draw.'" One of the things to remember in any case with reference to the cylinder and concave is that it is very good policy to use the least number of teeth in the concaves and the fewest concaves adequate for threshing the grain from the heads properly. This is important since it will save power and it will materially lessen the amount of broken straw, which is a decided advantage. This broken straw makes operation more difficult since it always overloads the straw racks and sieves and makes difficulties in the way of cleaning.

The *separating parts* are the mechanisms from the cylinder rearward. The straw passing through the cylinder travels at a rate of about 6000 ft. per minute. From here it is carried over a grate, usually

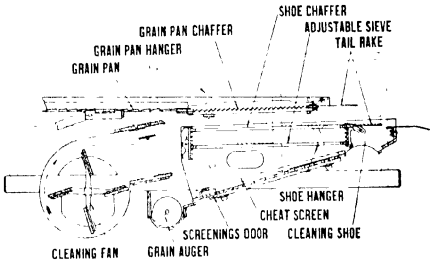


FIG. 196.—Section through cleaning shoe, and fan showing sieves and screens.

to a beater and straw racks or shakers, where its travel is reduced to about 40 ft. per minute. This change takes place in a distance of about 2 ft. These straw racks are usually from 10 ft. to 14 ft. in length. The different machines all have mechanical devices that differ, yet aim to produce the same results—viz.: to remove the grain from the straw by agitation. It has been found that about 90 per cent of the separation takes place at the cylinder and grates. The remaining length of the machine must therefore be able to separate what grain is left by thoroughly shaking or agitating it. This is the difficult task.

Straw racks are usually not at all adjustable. The various

manufacturers make differences in them, however, to suit various localities. The Southern States and the Western Arid Country get racks that are slightly different from those that are regularly used. The difference is only in closing up the openings somewhat, since the straw in these localities is more brittle and the closing is done to avoid overloading the grain pans or conveyors with much of this short straw.

The operator must be absolutely sure that the straw racks have their proper motion or speed. This is very essential and should be carefully looked after. If the speed lags for any reason whatever, the straw accumulates and it becomes almost impossible to separate the grain from it. This means wastage. Very often a loose belt will allow this to happen. If the whole machine slows down the racks, too, will slow down in proportion, so that the results are entirely unsatisfactory. Excessive speed is equally bad. This will cause the racks to carry grain over with the straw instead of letting it fall through these racks. Then too, much of it is in reality thrown out by fast action of the straw racks. To get the very best results, therefore, the straw racks should run at their proper speed.

The cleaning devices are composed of the fan, the shoe, and the sieves. As the grain is separated from the straw it falls through onto the conveyor or grain pan and is conveyed toward the rear to be cleaned. A blast of air from the fan, acting on the sieves in the shoe and rear end of the conveyor does this cleaning. Very close adjustment is necessary to accomplish this satisfactorily.

Fans are of two types, over-shot and under-shot. Design of relative parts makes the work of both equally good.

Shoes differ in that some have a longitudinal shake (end shake) and others a side shake. The former are most common. These do equally good work although the former has found more favor.

The choice of sieves depends upon the grains being threshed. Most of our modern threshers have adjustable sieves. These can be set to suit almost all small grains. They are used in

the grain pan and in the shoe. It is even possible to adjust them while the machine is running. This is very often found necessary and, therefore, it is a big advantage. Frequently an extra lip sieve or perforated sieve can be used in the shoe underneath the adjustable sieve. For very dirty grain a screen at the bottom of the shoe is used to remove the dirt. It also removes many foul seeds such as cheat.

The angle at which the sieves are set influences the work of the thresher. This, together with the adjustment of the fan blinds, makes for good or poor cleaning of the grain. If grain is found going over the adjustable sieve or the grain pan into the tailings auger, it is probably due to the fact that this sieve is closed too much. In such cases it should be opened more to let this grain through. Opening this sieve too far lets much chaff through on the shoe sieve and overloads it, which also causes grain to go into the tailings auger over the adjustable shoe sieve.

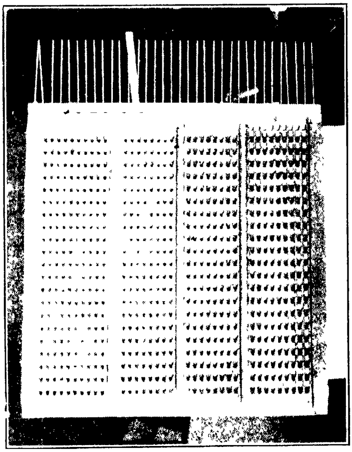


FIG. 197.—An adjustable sieve.

The shoe sieve may be closed too much, which will bring about the same results. It is also necessary sometimes to raise the rear end of this shoe sieve or lower the front end to get the grain through. By raising the rear it is more difficult for the grain to go up and over. By lowering the front, which is preferable, the same thing is accomplished, and besides, the blast from the fan can get over it easier and act more forcefully. Wastage here often occurs by getting too much blast from the cleaning fan on the sieves, and grain is

blown over the sieves and out at the rear. Any fan blind adjustment on one side of the machine will be found to affect the opposite side of the sieves. This is because the wind is drawn into the eye of the fan and passes over to the opposite side where it is blown out by the fan wings. This applies particularly to under shot fans.

If common sieves are to be used instead of adjustable, it is well to have a good assortment This will be found essential for good work in threshing different grains. Frequent changing is necessary. The use of the proper sieve is an item of importance that needs careful consideration.

What has been said about adjustment of adjustable sieves also applies to the plain perforated or lip sieves, except that, of course, the sieve needs to be changed to get larger or smaller openings to let grain and fan blast through. The bottom of nearly all shoes may be provided with a screen This may be used if foul seeds or dirt are in the grain This affords more thorough cleaning and is an advantage Usually these seeds or the dirt fall out through the screen upon the ground. If grain is at all damp, the operator should look at the sieves very often as sieves in such conditions clog up very easily and quickly. The screen, particularly, is apt to clog. In any case, the operator should use the largest possible openings in all sieves and the smallest number of sieves consistent with good work.

The tailings auger and elevator are essentials and it may be seen that the auger or conveyor at the rear of the shoe communicates with the cylinder at the end of the tailings elevator. Its purpose primarily is to catch any unthreshed heads which may have gotten past the cylinder and concave teeth, and return them so that they may be properly threshed. It, therefore, is a useful part of a thresher. However, the amount of unthreshed grain is usually very small, at least it should be if the machine is properly operated. In fact, the amount and condition of the tailings will instantly reveal to an experienced operator the work that is being done by the machine as a

whole. This is important and needs constant attention. Many tailings make operation difficult. To be able to thresh with a minimum amount is usually an indication of good work and a credit to the operator of the machine.

Oiling.—The bearings of the threshing machine as a whole should be well and frequently oiled. The cylinder being the most important part of the machine has bearings that require particular attention. If they are of babbitt they need oiling at least every hour. They need to be very carefully and consistently tended. If anti-friction bearings are used they need oiling only once every two or three days. Danger from hot boxes is entirely eliminated with such equipment.

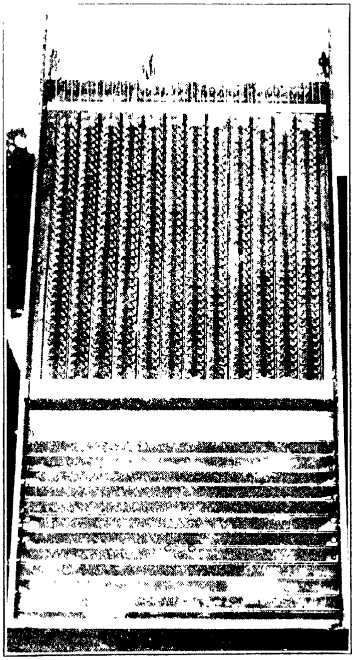


FIG. 198. A lip sieve in a grain conveyor or shoe.

The crank shaft boxes, the beater and fan boxes and the feeder cylinder or crank boxes should be oiled every few hours. All bearing boxes on the machine need oiling every morning and noon during the threshing season. It is well to remember that a little oil frequently applied is far more effective than a larger quantity applied at long intervals of time. It is well to remember that the truck wheels of the machine should be greased at every resetting.

Attachments.—Attachments such as the feeder and wind stacker, or blower as it is commonly called, and the grain handling devices are today on about 95 per cent of the threshers purchased. These are merely attachments, but perform valuable functions. Their use on a machine, while not an absolute necessity, is of economic value, since any one will pay for itself in a single season by saving help that would otherwise be required in order to do the work properly.

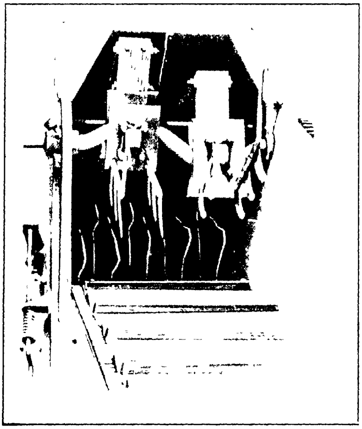


FIG 199.—A crank-shaft knife feeder.

Function of the *feeder* is to deliver the bundles of grain to the cylinder with the bands cut and the bundle separated so that the work of the cylinder may be most efficient. There are two types of feeders. The rotary knife and the crank shaft knife. In some sections, particularly where much short straw and headed grain is to be threshed, the crank shaft type has been found most practical. The rotary knife feeder needs special attention to keep the knives sharp enough to cut the bands. On the crank shaft type no special attention need be given to the knives.

Then, too, there are two distinct types of feeder carriers. One is the wing carrier type and the other is the plain rake carrier. Of the latter type some are made with an open slatted rake. Others have a canvas apron with slats on the outside. The latter has advantages, in that less wastage and litter is usually found about the parts of the machine. For headed grain it is a decided advantage.

On the larger rigs an extension carrier is often used in connection with the regular feeder. This is best suited to headed grain threshing or for use on large custom threshing machines. Of course, good work cannot be expected if the pitchers do not feed to the feeder properly. They should always keep the feeder carrier full. The bundles should always be put in lengthwise and heads forward, that is, toward the cylinder. When plenty of power is available and the machine is big enough, bundles should be lapped half and half. The feeding of the grain to the thresher has a decided influence on the work of the threshing as a whole. The more uniform the feeding, the better will be the job of threshing. This should be remembered.

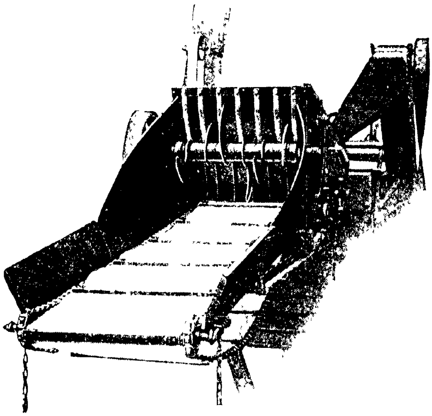


FIG. 200. A rotary knife feeder.

Nearly all feeders today are provided with speed governors. Their purpose is to stop and start the feeding device as the speed varies. They usually are made so that the feeding rake or apron is stopped while the balance of the feeder continues to run. If, for instance, the thresher cylinder speed should drop say 50 R P M., the feeding rake would stop immediately. It would again pick up and feed as soon as the normal regular speed was reached.

As said before, the thresher does not work well if below its regular speed. To take care of this has been the purpose of the designers of feeders. It follows that the speed governor

should be very carefully set to see that it does its work properly. Another thing the speed governor does is to keep from overloading the cylinder Since too heavy a feeding may result in a reduced cylinder speed, it follows that the feeder rake stops long enough for the cylinder to clear itself sufficiently to get back to proper speed before feeding is again resumed.

On some feeders, volume straw governors are used in addition to the speed governors These are influenced by the volume of straw fed to the machine. They may be set so that a

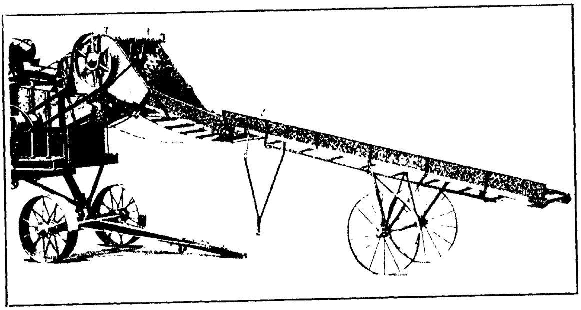


FIG 201--An extension carrier for feeding

uniform volume can be fed continually They act on the feed rake or apron and stop it long enough to reduce the quantity or volume and again automatically start feeding When properly set, as they should be, they help considerably. It is often possible to gage the quantity of straw fed to the machine by this volume governor to suit the power available in the tractor. This alone often makes them a very valuable part of the rig.

Stackers of two different types are generally used on modern threshers. The common stacker which is only a raddle elevating device of the simplest kind is of earliest origin. Sometimes these are of the swinging style. The latter devel-

opments brought out the wind stacker or blower as it is generally termed.

When a common stacker is used it requires men on the straw stacks to care for the straw and build the stack. The blower eliminates this extra help because it has capacity to blow the straw directly to its place a considerable distance from the machine and at a good height.

A common stacker requires no particular attention other than keeping the rake or raddle running square on the stacker frame.

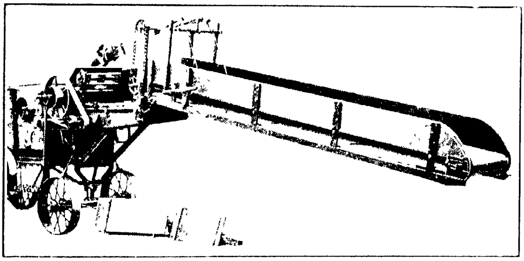


FIG. 202.—Feeder for headed grain. Used commonly in the Northwest.

The blower is even more simple for it requires no attention whatever except frequent oiling of all the bearings. If these fan bearings are of babbitt they need oiling every hour or two. If anti-friction, once every two or three days is sufficient.

The blower drive belt should be kept in good condition and reasonably tight so it will drive the blower at its proper speed to handle all the straw.

The straw chute on many blowers has a device for oscillating this chute so that it automatically builds a semicircular straw stack. Care should be had to be sure that the end of this chute, the hood, never gets close to the straw stack. This will prevent the straw and air from leaving which will plug the blower chute in a few seconds which often requires as much as a half hour to get cleaned out.

Grain Handling Devices are made to suit localities. These differ, and consequently the farmer may exercise personal preference in purchasing devices for handling the grain. In the northwest the high loader is used so that the grain may be put directly into a portable bin or wagon box. Many who do barn threshing, as is customary in the East, prefer a short bagger.

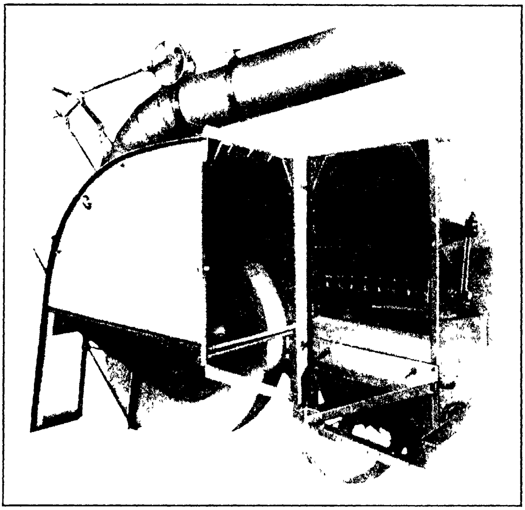


FIG. 203.—A wind stacker, hinged to give access to the interior.

The weigher is most popular. It is a very satisfactory and convenient device. It will weigh the grain and record the number of bushels handled. Spouts may be used to deliver directly into a wagon box or to sacks.

Most of these grain handling devices are similar. Some use chains and buckets for elevators, while others use a belt and bucket. In any case the adjustments in the main are alike. Before threshing it is well to check the weighing mechanisms.

This is done best by placing a half bushel of the grain to be handled in the hopper and balancing it. Ordinarily the beams are properly marked. When new, they are, no doubt, correct, but wear and usage may alter this. In any event, the percentage of error is very slight considering the rapidity with which the work is done. They need special attention in the way of lubrication at the head or top shaft, the boot or lower shaft and countershaft, when used. These run continually and handle all the grain.

Another feature is the adjustment for proper chain or belt tension on

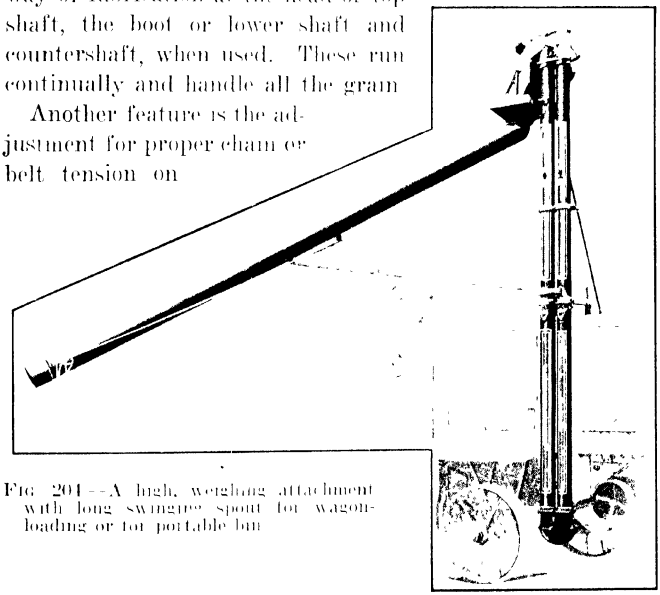


FIG. 201.—A high, weighing attachment with long swinging spout for wagon-loading or for portable bin.

the elevators. This needs watching. If too loose, chains often unhook and belts slip. If too tight, they cause unnecessary friction and rapid wear. Not alone will the chain unhook, but a loose chain may cause much damage by cracking grain. This is particularly important when wheat is being threshed. Very often the thresher is blamed for a fault which may be traced directly to the loose chain of this type of grain handling device. Added to that is the fact that, as previously

said, it may become unhooked. To those who have had this trouble during threshing time it is of vast importance. It may mean breaking a link or two or even the sprocket in boot or the boot casting itself. It is, therefore, important to keep these chains in good shape and run at proper tension.

Capacity.—The capacity of threshers will vary with the kind of grain being threshed, the condition of the grain,

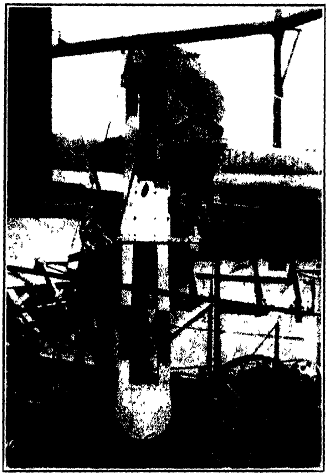


FIG. 205.—A grain weighing attachment of belt and bucket type.

whether it is dry or damp, whether it is threshed from the shock or stack, whether it has long or short straw or headed, and the yield.

The following table gives the capacities of threshers of average sizes in good running condition, with grain and straw of average yield and length and in good condition, with a minimum wastage, and with ample power to keep the machine running at its proper speed.

SIZE	APPROXIMATE CAPACITY IN BUSHELS PER HOUR	
	Wheat	*Oats*
18 x 34..............	25–40	50–75
20 x 35..............	50–80	90–155
24 x 42..............	70–120	140–200
28 x 48..............	90–140	170–250
32 x 55..............	100–160	200–300
36 x 60..............	125–175	225–350
40 x 65..............	140–200	250–350

The maximum capacity of any machine or any thresher must take into account the quality of the work.

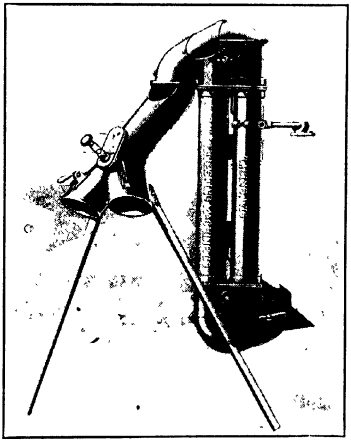


FIG. 206.—A short bagging attachment.

When the grain yield is only 12 or 15 bushels per acre the farmer must accept a small day's work in total bushels threshed as compared with the number of bushels that may be threshed in a day with a yield of 40 or 50 bushels an acre. The men who pitch the bundles onto the feeder also influence the capacity. A crew that will keep the feeder rake continually filled with bundles, lapped "Butt and band" will accom-

plish more in a day than a crew that will over feed one minute and let the machine run empty the next. Steady work maintained throughout a day will bring about results that make for good work and capacity to suit any owner of a thresher.

Power Required.—It should, first of all, be understood that threshing is very hard work and consequently requires a great deal of steady power. Most books, data sheets, tractor catalogs, and even manufacturers' catalogs give figures on this subject which are far too low. In some cases the manufacturer had recommended power which is 50 percent too low for threshing even the dryest grain. To thresh wet or damp grain requires more power than is needed to thresh dry again. More power is used in threshing long straw or turkey red than in threshing blue stem.

The following table gives the power required to run a thresher with attachments such as feeder, wind stacker, and weigher:

THRESHER SIZE (APPROX.)	GRAIN BEING THRESHED	HORSE-POWER REQUIRED
18 x 34.............	Blue stem	18–22
"	Turkey Red	22–26
20 x 35.............	Blue stem	22–26
"	Turkey Red	26–32
24 x 42.............	Blue stem	26–32
"	Turkey Red	30–40
28 x 48.............	Blue stem	35–45
"	Turkey Red	45–55
32 x 55.............	Blue stem	40–50
"	Turkey Red	50–60
36 x 60.............	Blue stem	65–75
"	Turkey Red	75–85
40 x 65.............	Blue stem	75–85
"	Turkey Red	85–100

These figures are based on field tests when the power was actually measured and are based on averages. The thresher in each case was working to capacity and was in first class shape so far as adjustments are concerned. In any case, it would be folly to attempt to get along with less power than

recommended herewith if economical, thorough work is desired, although if capacity is sacrificed to some extent the amount of power that will be required may also be somewhat reduced.

Regular and Special Equipment.—This refers to attachments for threshing different grains and seeds that are grown on the farm. Ordinarily threshers are equipped in two ways. One is termed "Regular Equipment" and the other "Special Equipment." Threshing machines with regular equipment for threshing wheat may be further subdivided into two headings which refer to the cylinder of the machine only. Since threshing turkey red wheat, or such varieties which grow in the Southwest, is much more difficult, it is necessary that the cylinder should be what is commonly termed "Full Spiked" which means that the maximum number of teeth are used in the cylinder. For threshing blue-stem such as grow in the West and Northwest, the cylinder is spiked with a minimum number of teeth. Wheat of the ordinary variety is grown far in excess of the hard varieties. Some manufacturers equip all their machines with the maximum number of teeth and call this a standard machine for use in any locality. Threshers, regularly equipped, and with either of these cylinders, will be able to handle all ordinary grains such as wheat, rye, oats, barley, flax, buckwheat, millet and spetz or emmer, etc. This means that the ordinary sieves which are used in the chaffer and shoe, with an additional one or two for shoe sieves or screens, will handle these grains successfully.

Machines with special equipment are those which must have in addition a special cylinder and pulleys, and sometimes a special straw rack, and concaves, as well as separate sieves for doing the work of threshing. Machines equipped in this manner are able to handle peas and beans of various varieties and kinds. They are also able to thresh rice of different kinds. Even seeds may be threshed after a fashion. Clover, alfalfa, lucerne, timothy, and orchard grass, etc., can be handled. In

many cases, since these grains are grown on the farms in small quantities, special attachments for this work are practical and will do satisfactory work. If, however, large quantities of small seeds are grown on the farm a regular huller will be found most satisfactory.

If peanuts are the predominating crop on the farm, it naturally follows that a peanut thresher, or a peanut picker, which is a special machine for this work, should be used.

Where peas and beans are grown in large quantities, and where they are the predominating crop, it is reasonable to suppose that a special machine for this purpose will be used. These machines, although threshing machines, are usually provided with two cylinders and sometimes with three, and are used exclusively for threshing peas and beans. Unless the acreage grown is very large, it will not pay to use a machine of this sort. Therefore, where only a small amount is to be threshed, it is practical to procure special attachments for the regular threshing machine for doing this work. The sieve equipment for threshers for these different seeds and grains should be carefully selected to be sure that the proper one is being used to get the best results.

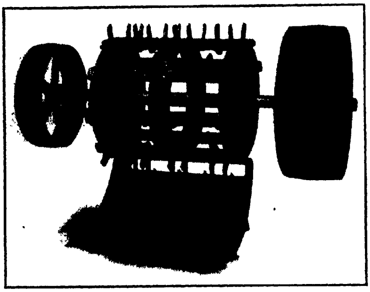


FIG. 207.—Regular grain-thresher cylinder with some teeth omitted and special concaves added for handling peanuts.

These specially equipped machines for threshing rice, peas, beans, or peanuts have cylinder speeds much below those which are used when grain is being threshed. This, therefore, calls for special pulleys on the cylinder—not alone the main drive pulley, but also those that drive other parts of the machine from the cylinder. Manufacturers making threshers list these

various attachments, which cover all the parts necessary to permit using the machine for handling these other crops. When it is desirable to thresh any of the various seeds or grains mentioned, the manufacturer should be consulted and his recommendations carried out, because very often a sieve equipment or pulley equipment for one make of machine would prove entirely unsatisfactory for another. Directions accompanying these attachments will explain in detail just how they are to be put on, and the method of operating them to the best advantage. It should be remembered that these machines with special attachments are still threshers and should be run as such.

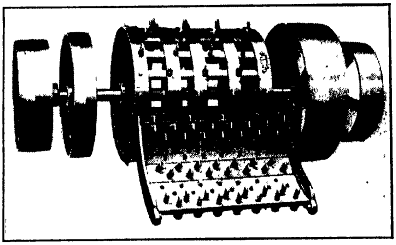


FIG. 208.—A cylinder and concaves for a regular thresher with teeth spaced for handling peas and beans. Note special pulleys.

What has been said about running a thresher and the care of its various parts, holds good when these attachments are used. Rice, peas, beans, and peanuts are more brittle than grain, and the speeds that the manufacturers recommend are critical and should be maintained uniformly if good results are sought. Then, too, it is to be expected that an attachment for a grain thresher handling peas or beans will not do as good a job as a regular bean thresher. Neither will an attachment for handling peanuts do as good a job as a regular peanut thresher or peanut picker. Even an attachment for clover hulling will not do as well as a regular huller. They will, if properly run and carefully operated, do a satisfactory job of special work and get more days' work out of the threshing machine. These attachments, therefore, are a means of reducing farm machine costs, by enabling the farmer to do various jobs that otherwise would require special machines.

Waste.—This refers to grain that is lost in threshing, most of which goes out with the straw. There never has been a threshing machine built and used that saved every kernel of grain. Too often the farmer will find a few kernels in the straw stack and instantly conclude that he is losing from 10 to 20 percent of his grain. Even though the amount of waste grain was as much as passes through a grain drill tube in a 10-hour day only about a bushel and a half would be wasted. Threshing at the rate of 150 bushels an hour this would amount to only one-tenth of one per cent. The wastage of grain by a threshing machine if properly operated is generally and on the average less than one percent. When one really considers the work that a modern threshing machine does and its importance in our farm work this figure becomes insignificant.

Peanut Thresher

Since the peanut thresher is primarily a threshing machine, what has been said in the early part of this chapter on this subject is in the main applicable to the successful operation of these machines.

Since, however, peanuts are very brittle, it follows that the cylinder speed must be materially reduced, usually about one-sixth the speed used for threshing grain. In the localities where peanuts are grown in quantities, it is a good plan to have the machine equipped with such parts as will reduce breakage to a minimum. Where peanuts are the predominating crop, a special peanut machine may prove valuable. When an ordinary threshing machine is converted into a peanut thresher it will in most cases do a satisfactory job of peanut threshing. Such machines often do not attempt to convey the peanuts by augers or elevators, but use shakers instead. This is done because these augers and elevators break the shells very easily, particularly on the small varieties or Spanish peanuts. These machines do not require a feeder but may be run best if

provided with a hand feeding attachment instead of any kind of an automatic feeder.

Growing like potatoes, right in the ground, peanuts are very dirty and dusty and what has been said about oiling the threshing machine will especially apply to this machine. Fine sand and dirt is usually removed by passing the peanuts over perforated screens. They should therefore never be handled unless perfectly dry. To clean them thoroughly and deliver them to a sack calls for special care with reference to wind adjustments and sieve settings. Care should be exercised to prevent wastage; in other words, that the peanuts are all removed unbroken from the vines. Breakage of peanuts is largely due to improper adjustments of the cylinder to where most of the breakages may be traced. It may be due to a speed that is too high or it may also be due to the fact that the cylinder teeth are not traveling midway between the concave teeth Too many teeth used in the concave will cause the breakage. These two things should be closely watched to be sure that there is no fault at the cylinder.

Whether the peanuts are threshed with a threshing machine with peanut attachments or whether they are being handled by a special machine for this purpose, this work should be very carefully done in order to reduce the breakages. Peanuts grown to be marketed will grade low if many are broken. Handling peanuts, like handling peas and beans, is a job that requires expert handling of the machine. Cleaning them may be done without any difficulty if some judgment is used to select sieves and screens in proper proportion to the peanuts being threshed.

The capacity of peanut threshing machines may be taken at a little less than one-half of the figures given for the capacity of regular machines threshing wheat. A 24-inch peanut machine, under favorable conditions, will thresh and clean from 30 to 50 bushels an hour. A 28-inch machine from 40 to 60. Yields and varieties will influence these figures.

The power required to thresh peanuts is about one-half the

figures given for threshing blue stem wheat with a regular machine. A 24-inch machine would require from 9 to 11 horse power and a 28-inch machine from 11 to 13 horse power.

This figure is less because no feeder or wind stacker are used and besides the speeds are lower and due to the fact that peanuts are not at all hard to thresh from the vines.

CHAPTER XIX

SILAGE CUTTERS

These machines are also termed "Silo Fillers."

Function.—The purpose of this machine is to cut the material, usually corn, most generally very green, into short lengths (about ½ inch) and to deliver it into the top of the silo, regardless of height. It should cut clean, of uniform lengths, cut all the material fed to it, and deliver it into the silo with the least expense of power and labor and in the shortest possible time.

Types, Sizes, and Rating.—There are two very distinct types or kinds of silage cutters. They are commonly termed the "Cylinder" type and the "Flywheel" type. The cylinder is often termed "Lawn Mower" type. The flywheel is often termed a "Knife Wheel" type. Either of these types is also procurable with a slatted elevator, either open or closed, instead of the blowing device. The only advantage over the blower is reduction in power required. These machines, however, are more difficult to set up and to move from place to place. They are also more liable to litter. If properly set and adjusted they may require less power to operate, but they do not have the capacity of the blower, and need more attention and room in the barnyard when set up for work.

Machines are made with a chain feeder or hand feed. In the former case the feed table has a traveling chain-rake which delivers the corn bundles to the feeding mechanism which in turn delivers them to the knives to be cut. The hand feeding device, as the name implies, must be fed by hand.

On the flywheel type the fan blades are secured directly to the knife wheel disc itself, which is also the fan or blower since

the blades are secured to this disc. The cylinder type machine has an independent blower for elevating the silage. Silage cutters are made in various sizes and are rated by numbers which are usually given in terms of inches, representing the width of the throat or feed opening. A 13-inch machine would, therefore, have a feed roll width, or a throat 13 inches wide, or a number 14 machine would have a throat or feed opening 14 inches wide, and so forth. Some manufacturers have selected arbitrary numbers which have no relation whatever to the size of the machine. This distance

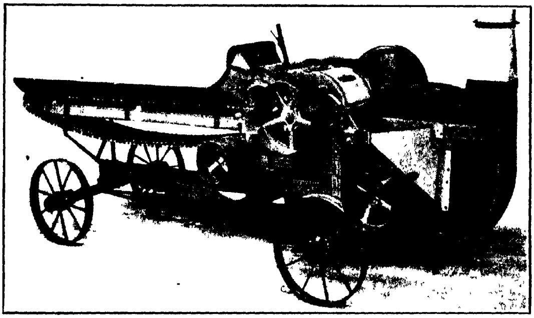


FIG. 209.—A "cylinder" type silage cutter.

varies on different sizes from nine inches to about twenty-five inches on machines of both types. It is, however, only nominal and may vary one-quarter to one-half inch either way and yet be described in terms of even inches.

This great range is due to the fact that cylinder machines do not have the vertical throat opening that the flywheel type has. To get the same area of throat, therefore, it becomes necessary to increase the width of the throat. In other words, a cylinder machine with a throat opening of three and one-half inches in the vertical direction would have twenty-four inches of width to correspond in area with a flywheel machine

that was twelve inches wide, but had a vertical opening of seven inches.

Field Operation.—Setting is the first step in the correct field operation of an ensilage cutter, which includes getting it properly set, blocked, and belted to the tractor.

To begin with, the machine should set just as close to the silo as possible. This is done to get the blower pipe in a vertical position or at least as nearly vertical as possible. It very often happens that when the pipe has a slight angle, the heavy ma-

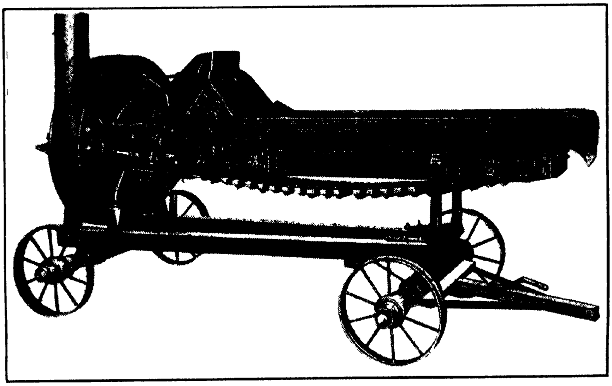
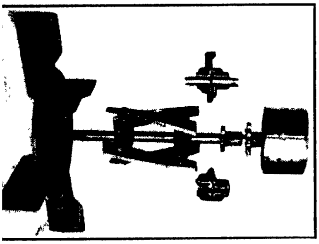


FIG. 210.—A "fly-wheel" type silage cutter.

terial, the silage which is being blown through this pipe, settles to the low side and lets the draft or the blast go by above it. This material begins to accumulate and pile up on the low side, which finally plugs the blower pipe. The elbow should be placed well into the silo so that the distributor pipe hangs as near the center of the silo as possible. It is a good plan to see that the lower end of the distributor elbow, particularly on those that are open, does not rest on the edge of the upper end of the silo or on the small doorsill so that the passage of the cut material is hindered. Another thing that deserves careful attention is the fact that the blast of air which comes into the

o with the silage, and, in fact, carries it, must have an outlet. is well, therefore, to keep the doors of the silo removed and t them on only as filling progresses. Field experience has vealed that frequently a machine is condemned as not capa- of blowing silage into a silo for no other reason than that ovision for the escape of air has not been made.

Machines that use the carrier of either the open or closed pe must necessarily be set quite a distance from the silo to be re that the return chains have proper clearance and will not t caught. Another item of importance in setting the machine is to be sure that it is properly staked down. When the engine is backed into the belt there should be enough tension on this main drive belt to transmit the necessary power and this means holding the silage cutter in its proper place. This can be accomplished best by driving stakes into the ground in front of the achine so that it will keep its location. The machine should so stand level and be square with the tractor. It is a good an in setting the tractor and the machine to leave room so at the wagons that deliver corn to the feeder have ample om to get away when unloaded, either by backing or turning.



G. 211.—The knives of a "cylinder" type machine but with blower fan directly on cylinder shaft.

Speed is usually measured by the revolutions that the knife heel or cutter head will make in one minute. It is customary r the manufacturer of these machines to have printed on em the speed at which they should be operated. It is quite iportant that this direction be followed very closely. This eed is usually based on the average height of silos, which ay be about forty feet. For silos sixty or seventy feet high, even higher, it may be found necessary to increase this

speed considerably to blow the silage to the top. It would be well, in any case, to take this up with the manufacturer before increasing the speed materially because there is danger, if machines are run at too high a speed. Any machine that is run too fast is very apt to cause trouble since the centrifugal force might burst the rotating parts.

The knives have the hardest work to do, and it is of utmost importance that they be kept sharp. A new set should be put on the machine every half-day or after every four or five hours running. It is well when purchasing the original machine to get an extra set of knives if they are not regularly furnished. By sharpening both sets in the evening after the work is done, or early in the morning before it begins, no time need be lost doing this work during the day. The power required to run a machine is largely proportioned by the sharpness of the knives; and this must, therefore, be watched very closely. In grinding these knives, care should be taken to maintain as nearly the same bevel and same shape as was on the knife when it was originally received; otherwise the work of the machine may be seriously impeded. If grinding is done on an emery wheel, care should be used to avoid letting the steel get so hot that the temper will be drawn and the hardness thereby reduced. A grindstone is desirable for such work, and, although slower, it is very satisfactory.

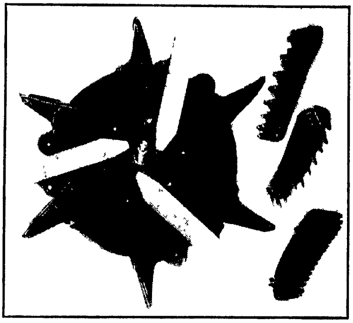


FIG. 212.—The knives of a "fly-wheel" type. (Inserts show shredding knives which may be added.)

The adjustment of the knives—setting them up to the shear plate—is also very important. The knife must not rub on this

shear or cutting plate; in fact, it should never touch the plate. It may be a good plan to set the knives a little closer at the hub end of the wheel (on the flywheel type cutter) than at the outer end. If the outer end is set the thickness of a piece of cardboard, or a scant one-thirty-second of an inch from the

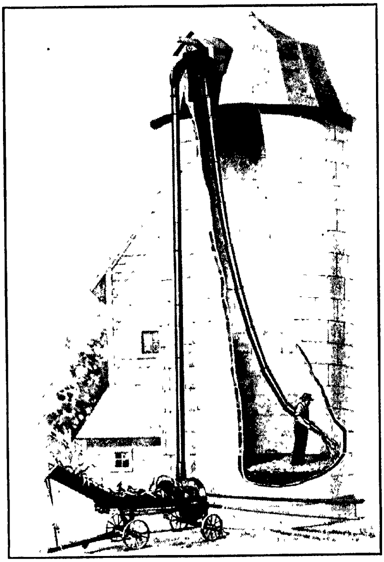


Fig. 213.—Correct setting of silage cutter and distributor. Note vertical blower pipe.

cutting plate, and the inner end about one-half as much, or one-sixty-fourth of an inch, it will be found very satisfactory for flywheel type cutters. This is done to allow the outer edge of the knife some leeway in moving toward the cutting plate as the work is done. This is often referred to at the factory as setting the knife with "draw."

On the cylinder type cutters careful adjustment should be

obtained similarly, except that these knives should be set with equal clearance from end to end and this should be about one-half the thickness of a piece of cardboard or one-sixty-fourth of an inch. It is well, each time the knives are removed, to check this clearance on each knife to see that it is in accordance with the above. The cutting or shear plate on any type of machine should also be kept sharp. This will not need grinding more than once a season and often not even that. Some cutters have this cutting or shear plate made so that it may be turned over as one edge becomes dull and a new edge may be

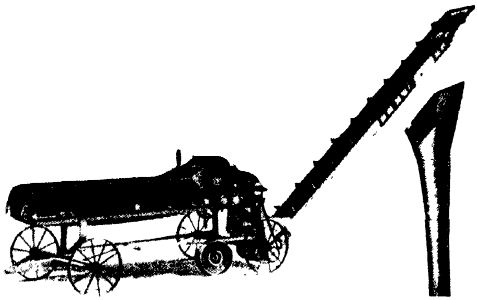


Fig. 214.—An enclosed carrier for elevating the silage instead of blowing it.

presented which will form a perfect shear cut with the knives. On some, three cutting edges are provided, and on others four; but care should be exercised to see that whenever this plate is removed it is bolted back in place very securely. In fact, it is well on any machine to frequently examine the bolts that hold these shear or cutting plates in place to see that they are tight. On machines where this cutting plate is of chilled iron and set in dove-tailed notches, a locking bolt too is used. This, therefore, needs to be kept tight to be sure that the cutting plate is securely held in place.

It is also quite important to be sure that the upper part of the case which was opened to get access to the knives is in its

proper position and very securely fastened before starting the machine. This should be tested by turning the cutter around several times by hand after this work is done.

Length of Cut refers to the length that the corn or other material is being cut by the machine. It may be changed, and varies on most machines from about three-eighths of an inch to about two inches. It has been found that a length of about one-half inch is very satisfactory. It packs well into the silo, which makes for good silage. This short length permits getting maximum capacity from the silo and the machine. The travel of the feed rake with a fixed number of knives governs this, and it is easy to see that the slower it travels the shorter the material will be cut; and by the same token, the faster it travels the longer the material will be cut. Adding knives to the machine reduces the length and removing them lengthens the cut. The custom machine operator will usually cut in as long lengths as he can. It is his purpose to do as many jobs of filling as possible each season. He, therefore, speeds up his feed apron so he can cut long and hurry the job. This is not satisfactory for the final results sought. The farmer, therefore, should watch this, whether it be a job of filling by a custom machine or even the farmer's individual machine. Long cut material does not pack so well in the silo as short lengths, and since good silage is made by packing

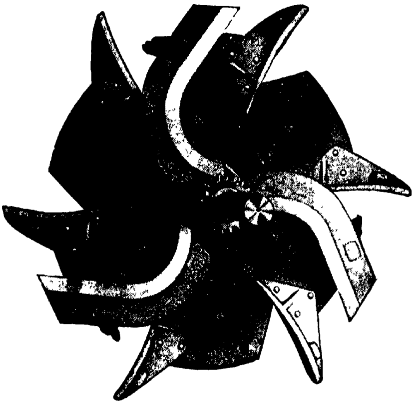


FIG. 215.—A knife wheel with curved knives.

well and expelling the air, it may be seen that the better it is packed the less air will be present; therefore, the better the silage.

Feeding.—To get the best results from this machine means that the feeder should be kept full continually. By this, it is not meant that the machine should be crowded beyond its capacity, but the bundles should be fed evenly, and not intermittently, as when the machine is allowed to run empty every alternate minute or two. The operator of the machine can watch this carefully, and it is a good plan to lap the bundles about one-half. In other words, when feeding butt end first, which is the custom, they should be lapped so that they come to about the center of the preceding bundle, feeding "butt and band" as it is commonly termed. If this procedure is followed carefully, much work can be accomplished in a short time if ample power is provided. The amount of work done in a day will be far greater as a result of feeding steadily and evenly, than if one tries to crowd through a great deal at shorter intervals of time. The result will mean a longer life for tractor and cutter, and better performance of both machines throughout.

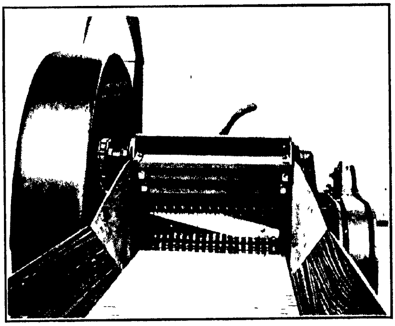


FIG. 216.—Throat and feed rolls of "cylinder" type machine. (Blower on cutter shaft.)

Care should also be used to see that the feed apron chains are properly adjusted. They should be set with just the correct amount of slack to prevent buckling. This does not mean that they should be so tight that they will cause unnecessary strain on the bearings, but it does mean that the performance

of the feeder will be at its best when they are set with this adjustment which calls for some slack.

Distributors are today very common, and practically every farmer who owns a silage cutter uses a distributer to help in this important work. These are usually made in sections three or four feet long, and fastened with snap hooks to each other. The whole distributer hangs at the end of the elbow at the end of the blower pipe. This device, as its name indicates, is a means for distributing evenly this cut silage in the silo. The man in the silo is enabled, by its aid, to direct the incoming material, to any place in the silo where he may want it. Ordinarily if this device is not used, the heavy particles coming from the pipe will practically all shoot over to one side, as determined by the position of the elbow. The light material will float about, and, of course, the side where this heavy material falls will be the only well packed part of the silo, and the result frequently is much spoiled silage. Before distributers were used, it was customary to have three or four men with forks distribute and tramp this cut material. By the aid of the distributer, however, one man can readily distribute the silage.

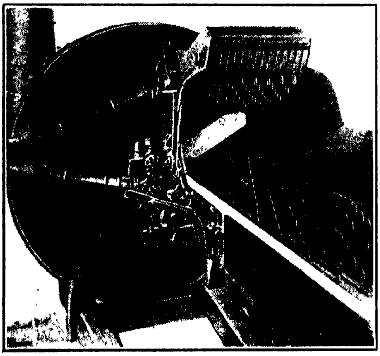


FIG. 217.—Throat and feeding device of a "fly-wheel" type machine.

Oiling—Since this machine has rather high rotative speeds, it follows that particular attention should be paid to oiling the bearings. The main bearings of the cutter on either type machine need particular attention since they must withstand not alone the work of cutting, but the pull of the drive belt

through which all the power is transmitted. Thrust loads too must be carried by the main bearings on either type machine. Very often a hot box will do sufficient damage to necessitate getting repair parts. The main bearings, particularly if of babbitt metal, need some attention at least every hour, and oftener if they show the least tendency to heat. It is well at this time also to oil all gear idlers or sprocket idlers and coun-

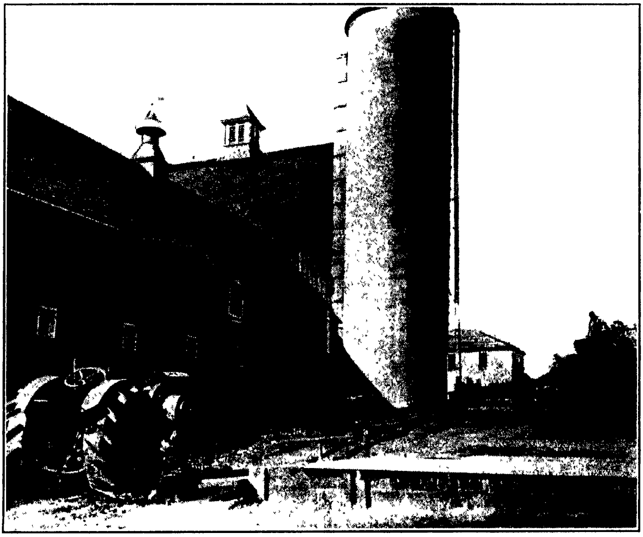


FIG. 218.—A splendid setting of cutter and tractor for rapid work.

tershafts of various kinds. It is well not to forget the small shaft at the front or outer end of the feed table. This is often neglected because it is a little apart from the body of the machine although it has an important function to perform. On machines that use roller chains or even sprocket chains of various kinds, it is well to see that they also are occasionally oiled. The face of the gears should be

greased from time to time and should always be kept covered so that there is no danger of foreign substances getting in between, which would cause trouble.

When anti-friction bearings are used on the knife shaft of these machines or at any other place, there is no danger from hot boxes. This, however, does not mean that they never require any attention whatever. Ordinarily, oiling them at the beginning of a season with a high grade medium oil with perhaps a tablespoon full each week, should be enough to last through the season or about thirty days. At the end of each season it is a good plan to flush these anti-friction bearings with kerosene to clean them thoroughly. Fill the box with a good grade of medium oil which will keep them in good condition. The truck wheels should also receive attention and be greased frequently with a good grade of axle grease, particularly if moved often.

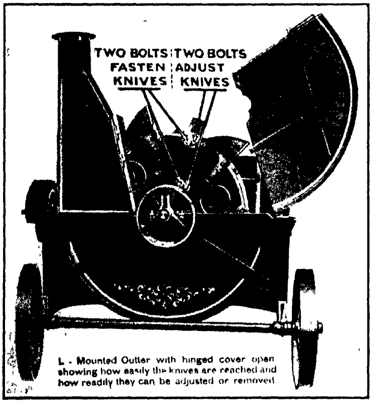


FIG. 219.—Knives on cutters are easily adjusted by opening cover provided for that purpose.

CAUTION ! ! ! When working on the machine at any time, even in changing the knives or oiling, it is well to remember never to place any tools on the feed table. Too often, a bundle of corn is hurriedly thrown on the table and covers a wrench of other iron parts which might be fed into the machine and do serious damage. The tractor engine should never be allowed to run even with clutch disengaged when any work is being done on the silage cutter such as changing the knives, etc.

DANGER ! ! ! Do not go into a silo that is partly filled without being sure that it contains fresh air. Silage in its process of sweating throws out carbon monoxide which is a poisonous gas. It is the same gas that comes out of the exhaust through the muffler of a motor car and is very dangerous. It is heavier than air, and, therefore, if the lower doors of the silos are left open until the silage reaches that point in height where it is necessary to have them on, no gas will settle in the bottom of the silo since it will then have an outlet and escape through this door opening. The best way to test the silo before entering it is to put a lighted lantern into the silo and if it remains lighted, fresh air or oxygen is present. If, however, the light goes out, it is due to the absence of oxygen and, therefore, the presence of poisonous gas. Removing the lower door of the silo will let it out, or better still, starting the machine and blowing into the silo for five or ten minutes without putting any corn into it will also drive it away by circulation.

Capacity.—Capacities of these machines are usually given in tons per hour. Unfortunately, however, since the material being cut varies in length from ¼ to 1½ or 2½ inches, due to gear or sprocket combinations, it can readily be seen that unless the length to which the material is cut is given, the capacity rating is rather vague.

The height of the silo has an influence on capacity for it is easier to blow silage 20 ft. high than to blow the same quantity to a height of 60 to 75 ft. This question of capacity of a silo filler is rather uncertain and indefinite. Manufacturers' catalogs do not all give the same data; therefore, the capacity figures given in various catalogs are not all comparable. Capacities differ considerably with reference to different widths of machines or different sizes.

The following table gives the capacities of silage cutters of various sizes (width of throat) and is based on cutting the corn ½ inch long and blowing into a silo 40 feet high. It is presumed that ample power is available for doing this work and that the cutter is in good condition.

CAPACITIES IN TONS PER HOUR

SIZE CUTTER	TYPE MACHINE	
	Cylinder	*Fly-wheel*
9	2–4	3–5
11	4–7	6–12
13	5–9	9–15
15	6–12	12–20
18	8–15	15–25
20	9–22	.....
25	10–25	.....

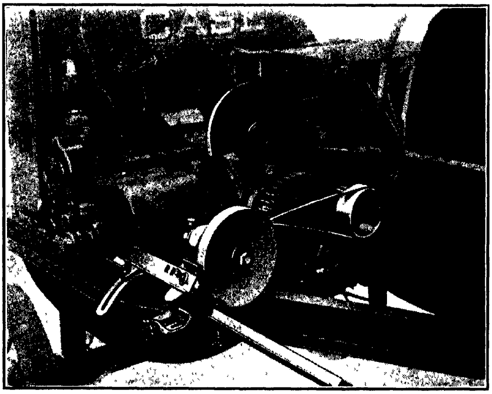


FIG. 220.—Knife-grinding attachments may be procured for most machines.

Power Required.—To run a silage cutter to capacity requires a great deal of power. Catalog ratings are very vague and indefinite on this subject also. At present one manufacturer gives his power rating as a steam requirement, while another may use gas power as his basis. This is very misleading, since the unit of horse power is the same for either gas or steam tractors. The power required to run a silage cutter depends on several factors. The sharpness of the knives and their setting, the height of the silo which is being filled, the

length the material is cut, and the condition of the machine as a whole with reference to its various machine parts, are all factors that have a decided influence.

The following table represents approximately the power required to run successfully silage cutters of the various sizes listed. It is presumed that the cutter is in first class condition with sharp knives correctly set and everything in good order, blowing to the top of a 40 foot silo:

POWER REQUIRED

SIZE CUTTER	TYPE MACHINE	
	Cylinder	*Fly-wheel*
9	4–8	6–12
11	6–12	10–20
13	8–16	14–25
15	10–20	18–35
18	12–25	25–50
20	15–30	.....
25	18–35	.....

CHAPTER XX

CORN SHELLERS

Function.—The purpose of corn shellers, regardless of type, is to remove the kernels of corn from the cobs, which is termed "Shelling," without damaging them and with the least possible breakage of the cobs. Most of these machines will shell either snapped corn, that is, corn with the husks on the ears, or husked corn. The sheller also cleans the shelled corn and separates all dirt and foreign material from the kernels. It removes all broken cobs, broken kernels and trash such as leaves, stones, and dirt, and delivers the shelled corn in a clean, first-class condition, usually into a wagon box. Government corn grading or grades which have been established during the past few years make the work of the sheller more important, particularly with reference to cleaning, since corn grades lower and, therefore, brings less money if not clean or if containing a great per cent of broken kernels.

Types, Sizes, and Rating.—There are two distinct types of shellers on the market and in use today. One is called a *spring* sheller and the other a *cylinder* sheller.

The spring sheller is generally used for individual or neighborhood work and is made in small units. Its size is given in terms of the number of holes it has into which the ear corn is fed. For instance, 2 hole, 4 hole, or 6 hole; the latter is usually the limit of size in this type.

Cylinder shellers are generally used for custom work, although some small single and some small double cylinder shellers are on the market, but they do not find as much favor for individual work as the spring sheller. Cylinder shellers are listed by some number that the manufacturer has adopted.

No consistent or logical rating has been devised which relates in any way to the machine size. They are rated in capacity of bushels of shelled corn that may be handled in an hour.

The large machines are generally equipped with dust collectors or dust fans, with drag feeders, and with other attachments that a custom machine would necessarily need for doing

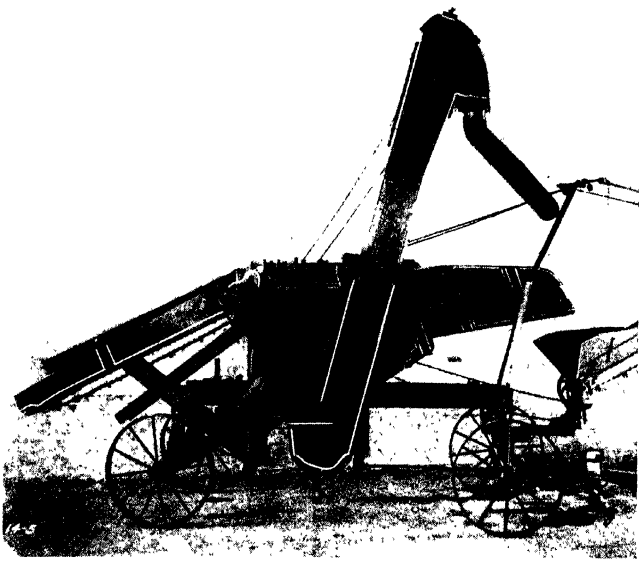


FIG. 221.—A spring sheller.

the work in a big way and economically. The spring sheller, being used largely for individual work, may not have all the attachments that are usually found on the large cylinder shellers.

Field Operation.—The first thing to do is to set the sheller properly so that the corn, if it is to be handled from the crib, can conveniently be fed either into the feeder of a spring

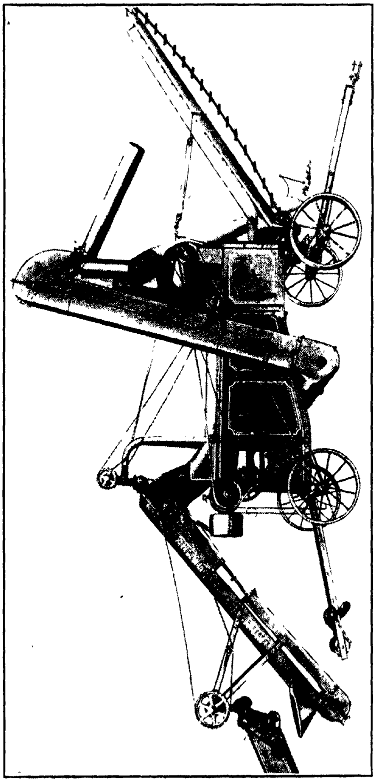


FIG. 222.—A cylinder sheller.

sheller or the extension feeder commonly called drags, of a large cylinder sheller. Care should be exercised to be sure that machine is set so that the cobs may be stacked in a place that will not be in the way of the wagons hauling the shelled corn. Frequently, the side drive affords a convenient method of belting to the tractor so as to avoid interference. This angle drive or side drive on shellers, therefore, is an added convenience on machines where the belt might interfere.

The drags or extension feeder on the larger machines are usually put into the corn crib in a place provided or built right into the crib for this purpose, or else laid alongside the crib. Where the crib has been built to take the drag, it is essential to guard against overloading in feeding the machine, which frequently occurs when such a large volume of corn is readily available and easily fed to the machine. Even in such cases uniform feeding makes for good shelling.

The outlet spout of the suction fan which carries away the dust and chaff should be set in the direction of the wind so that work around the machine is cleaner and more pleasant for the operators.

The speed of the main drive shaft should be correctly obtained. In shelling, like in most all belt work, it is essential that proper speeds be uniformly maintained. This may be different on various makes of shellers but ordinarily is about 800 R.P.M. One of the first things to consider is the kind of corn to be handled and whether it is picked or snapped. The second point is whether the corn is hard and dry, or very soft. Seasons vary, and this necessarily means that the corn is apt to be somewhat different during the seasons from year to year, or, frequently, owing to early or late cuttings, or early frost, it is apt to be quite soft in certain sections of the country while in other sections it may be in perfect condition for shelling. This variable condition of the corn calls for adjustments of the shelling apparatus to meet the requirements. An adjustment of these parts for hard corn will be entirely out of order for shelling soft corn. So, too, a

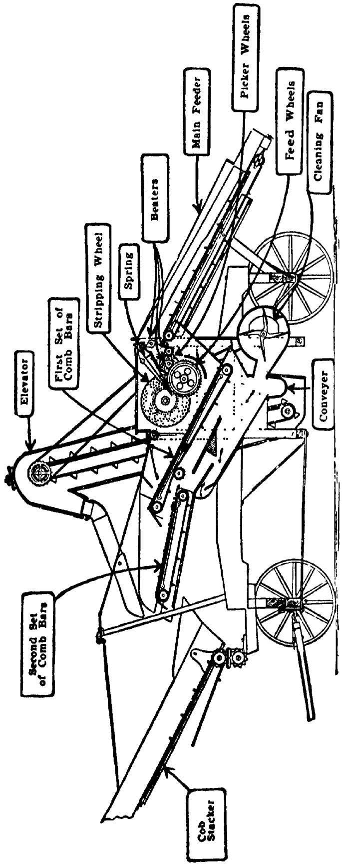


FIG. 223.—Sectional view of spring sheller.

setting of these parts for shelling snapped corn will be wrong for shelling picked corn. This applies to both types.

Feed chains on both types of machines should always be adjusted properly. They should feed properly the amount of corn necessary to keep the machine running to capacity and yet not so tight that they will heat the bearings and burn them out. A loose chain is very apt to buckle and break. This also means that it is apt to get into the machine and do much damage.

On spring shellers adjustments will be found for the rag iron so that it may be set to suit large or small corn and the tension on it may also be adjusted to suit hard or soft corn. This rag iron, however, has a spring pressure to accommodate different sized ears within a certain range. In no case should the adjustments of the rag iron be made so that unnecessary pressure is brought to bear on the ears being shelled. This rag iron holds the ears in place and only pressure enough to do this, consistent with good results, is necessary. Shelling damp corn or even soft corn calls for slightly more pressure as compared with well matured hard corn. The adjustment of the rag iron, whether tight or loose, has an influence on the quality of work done. If cobs appear with kernels on them, the rag iron should be set tighter. If, on the other hand, the cobs come out badly broken and chewed up, it indicates that this rag iron adjustment should be slackened up a trifle. The same adjustment should be made on every set in a similar manner.

Snapped corn which includes the husks must be fed to the machine considerably lighter than when husked corn is to be shelled. In other words, the capacity of the machine is cut more than in two on either type of machine and on some spring shellers it is difficult to handle snapped corn in any condition at all. The picker and the picker wheel on the spring sheller should always be kept in first class shape. The picker wheel, or straight runner, as it is often termed, revolves the ear, while it is supported and retarded by the rag iron on

which there is a high spring pressure, and in this manner presents the entire surface of the ear to the picker or bevel runner itself. The difference in rotative speed of the picker and picker wheel or bevel and straight runner causes the

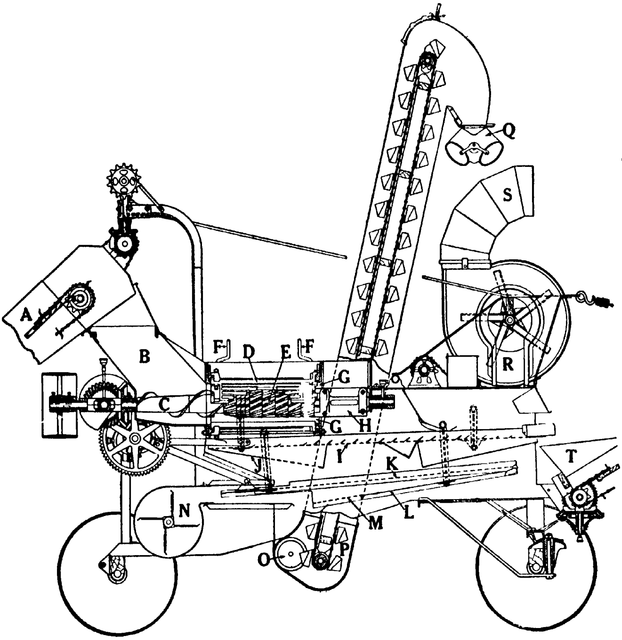


FIG. 224.—Sectional view of cylinder sheller.

shelling action which removes the kernels from the cob. Foreign substances, particularly stones, frequently get into these machines and do considerable damage to the shelling wheels by breaking off the small teeth or projections. This, therefore, needs special watching to be sure that they are in good condition and are sharp. End play should be reduced to a minimum because it allows these shelling wheels to touch

and damage each other. If worn from years of use, they should be renewed to get first class shelling. The bearings for both the picker and picker wheel or bevel and straight runner should continually be kept well oiled Since the drive for these wheels is usually by gears and the heaviest drive of the machine, it follows that these bearings and these gears need careful lubrication.

The cleaning of the shelled corn is done by a system of raddle rakes or by shakers and a series of sieves and screens. Sometimes a separate shoe with sieves and screens is ued to do specially good cleaning. The adjustments and setting of the shaker are usually constant. In other words, no adjustments are made, but the proper speed should be maintained by keeping the belts or chains in proper tension and since the shaker or raddle rake is usually belt or chain driven and has a fixed speed at which it should operate to do thorough separating, it follows that a belt must be kept at its proper tension to impart the correct speed to these parts to get good results from them. The sieves should be watched carefully to see that they do not plug up. There is a tendency toward this if there are many broken kernels in the corn or much trash present.

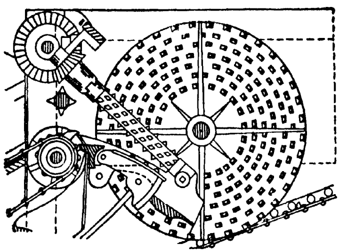


FIG. 225.—Shelling device of spring sheller.

The screen at the bottom of the shoe, or in the slide that delivers the shelled corn to the elevator, should also be watched to see that the fine dust and dirt is screened from the corn. This fine dust frequently accumulates under the screen to such an extent that it interferes with its work. This also should be watched carefully. The number of sieves used and the selection of their size is determined by the manufacturer. If any

adjustable sieve is used, the correct adjustment of it to get the proper cleaning of corn should be carefully watched.

Since the process of shelling in cylinder types is considerably different the adjustments are also considerably different. In these machines the ears are rubbed on each other or between the cylinder and concaves under it so violently and are turned so frequently by the action of the cylinder on the concaves, that the kernels are removed from the cobs in a very thorough manner. Most manufacturers stencil

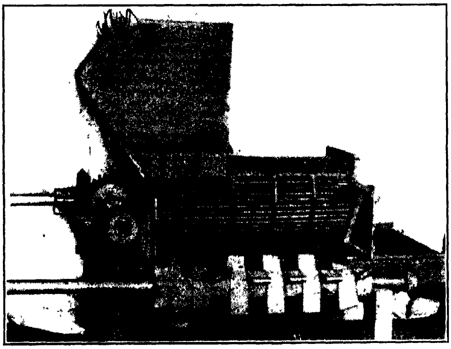


FIG. 226.—Concaves of cylinder sheller showing cylinder removed.

the proper speed of this cylinder on the machines and this should be carefully followed. The speed of the cylinder, therefore, is of the first importance. On these machines where the concaves or staves under the cylinder can be moved to and from it, this adjustment must be very carefully made to suit the size of the ears to be sure that the shelling is thoroughly done. On some machines the outlet at the rear end of the cylinder chamber has a governing means of some sort to hold the ears between the cylinder and this concave a longer period of time to get thorough shelling. The adjustment of this outlet gate, as it is termed, must be made after the machine is in operation, and this adjustment is determined

by the quality of shelling done. This again is influenced by the condition of the corn that is being handled.

If the shelling is thorough and the cobs badly broken, it is possibly due to the fact that the ears are held for too long a period of time against the cylinder. The remedy is a greater opening of this outlet gate. If, on the other hand, the cobs come out with kernels on them, it is due to the fact that they were let out too early. This would necessarily mean that the gate should be closed a trifle, or at least an adjustment made that would call for more work of the cylinder on the ears. On shellers that have adjustments of the concave staves no outlet gate is necessary. Therefore all regulation with reference to thorough shelling is proper setting of these concave staves to suit the size ears being handled. The concaves are very often made of chilled iron or steel bars, and after several years, and sometimes even after one heavy year of shelling, they need replacing. Ordinarily, however, they will last many seasons. At any rate, they should be kept sharp to do this work. The same thing is, in many cases, also true of the cylinder and its projections which often are short teeth. When the teeth in the cylinder are made of steel and inserted, it is necessary they too be watched carefully to see that the edges are sharp. On some machines inserted steel teeth may be turned to present new and sharp edges to the corn.

Cleaning.—What was said in the previous paragraph relating to spring shellers on this subject applies here also. Since the cylinder sheller, however, is usually provided with a dust collector, it necessarily follows that this should run at the correct speed to do good work. The belt should be kept tight to be sure the dust and chaff is removed, for unless it is removed by the collector, it means lower graded corn, because it would be impossible for the screen at the bottom of the machine to remove this dust from such a large quantity of corn. This, therefore, should be watched carefully to see that this fan does its work properly. When shelling snapped corn, the husks are also removed by the aid of this dust collector fan.

Oiling.—Since shelling is done very late in the season, often even during the middle of the winter, it follows that a reasonably light oil, say a medium, should be used as a lubricant. If a heavy oil is used, it must be kept quite fluid. This can best be done by keeping the oil cans (at least one of them) on some hot or warm part of the engine while the other is being used. It is a good plan to have two cans in any case. It is also a good plan to use the pump type with a small plunger in them so the oil may be forced to the various parts of the machine requiring attention. Where grease is used, care should be exercised to see that the cups are screwed down or given several turns quite often. The cold weather congeals the grease and frequently interferes with good lubrication. Very often the grease will not be soft enough to force into the bearings until the bearings have heated and sometimes then it is too late because damage has already been done which may be serious.

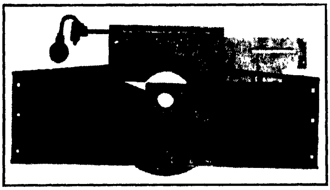


FIG. 227.—Outlet gate used on some cylinder shellers.

The main shaft on either the spring or cylinder sheller should receive special attention. The belt pull sometimes is excessive, much of it due to unnecessary belt tension. The picker wheel and picker wheel shaft on spring shellers also need special lubrication. On the cylinder sheller of the large type, where the dust collector fan is a part of the equipment, it is important that this fan be well oiled since it has a high rotative speed. The cleaning fan on both machines runs quite fast and should also be watched very carefully. The small bearings on the drags or extension feeders and even the cob elevator should be oiled occasionally. It is a good plan to oil all bearings often, using a small amount of oil each time rather than oiling with a large quantity at less frequent intervals.

Beveled gears that are used on the machines should be kept greased so that they may transmit the power with the least trouble and a minimum amount of friction. This is of particular importance when the angle drive is used. It is also well to remember that when these machines are transported from place to place the truck wheels should receive an occasional application of axle grease.

Fig. 228.—Separating device of a spring sheller.

The performance of the machine and its life are in a large measure dependent on the care they receive and the attention it gets in the way of lubrication. On machines where anti-friction bearings are used, it is well to be sure that at the beginning of the season's work all these bearings are filled with a good grade of medium oil. Other than this, they will probably need very little attention except perhaps a tablespoonful of oil added every three or four days. It is well to remember that a small amount of good oil frequently applied gives better results than flooding a bearing at long intervals of time. On slow-speed heavy-duty parts, the oil may be heavier than in bearings running fast, such as cleaning fan and dust-collector fan shaft. Anti-friction bearings, it must be remem-

bered, have a function to perform, and to do it well they must be cared for, that is, thoroughly cleaned and refilled with oil at the beginning of each season. The dust enclosure, that is, the felt packing, if it is used, should always be kept in first class condition to get satisfactory results.

Capacity.—The following capacities that may be obtained under good average conditions of husked corn for power shellers of the two types: A 2 hole spring sheller will shell from 75 to 140 bushels per hour, a 4 hole from 140 to 250 bushels per hour, a 6 hole from 200 to 360 bushels per hour and an 8 hole sheller from 360 to 500 bushels per hour. If snapped corn is being shelled these figures should be reduced at least one half.

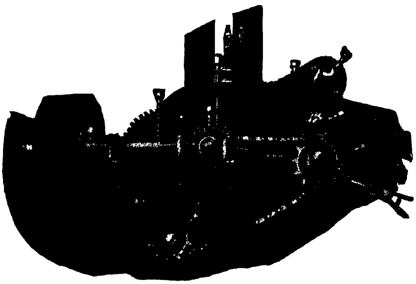


Fig. 229.—Angle drive for use on either type machine.

A cylinder sheller of medium size will shell from 375 to 700 bushels of husked corn and from 125 to 250 bushels of snapped corn per hour. A large cylinder sheller will shell from 650 to 1200 bushels of husked corn and from 200 to 475 bushels of snapped corn per hour. Large custom machines are on the market that are able to shell as much as 1600 to 1800 bushels husked corn in an hour.

Power Required.—To shell corn under average conditions requires that the machine run up to its proper speed, and under good general conditions a spring sheller of the 2 hole size will require from 6 to 8 horse power. A 4 hole sheller from 8 to 12 horse power, a 6 hole from 10 to 14 horse power and an 8 hole from 14 to 20 horse power. These figures are

based on the capacity listed in the preceding paragraph and for husked corn. If a suction fan is used an additional 2 horse power should be provided. If a drag feeder is used, it will be good policy to add 2 more horse power.

FIG. 230.—A shelling scene. Note husks in foreground removed by suction fan.

A small size cylinder sheller with all the attachments that usually go with this type will require from 24 to 30 horse power. A medium machine requires from 30 to 40 horse power, whereas a very large, custom machine with complete attachments will require from 50 to 75 horse power to run to capacity.

CHAPTER XXI

HUSKER-SHREDDERS

Function.—The purpose of the husker-shredder is to handle shocked corn, to remove the ears from the stalks, also remove the husks from these ears, to shred the stalks, and blow them, together with these husks, into the mow of a barn. Incidentally, in this process some corn is shelled from the ears. Means are provided to separate these loose kernels from the "stover," as the shredded material is commonly termed, clean them, and deliver the same into a sack on a bagging attachment provided for this purpose.

An elevator to convey the husked ear corn to a wagon box is provided to facilitate great capacity with a minimum amount of help.

The cornstalks may be cut into short lengths instead of shredding them, by substituting a cutting cylinder, instead of a shredding cylinder. The latter is most common and has found favor with most farmers who claim it makes the corn stover a more palatable stock food.

Types, Sizes, and Rating.—These machines are made in two types. One is termed "The Independent Snapping Roll Type" and the other, "The Combination Husking and Snapping Roll Type."

In the former case the snapping rolls are set horizintally, and usually crosswise on the machine. Their length is approximately the inside width of the machine. They are always used in pairs. A machine may be of the single or double snapping roll type. In these machines the husking rolls set below and forward of the snapping rolls, usually at an angle of about 15 degrees, so the ears tend to work

down this decline by gravity. They are aided by mechanical devices, also. These devices also rotate the ears while on these husking rolls to present the entire area to the action of the rolls. On some machines, however, these husking rolls set horizontally and at right angles to the snapping rolls.

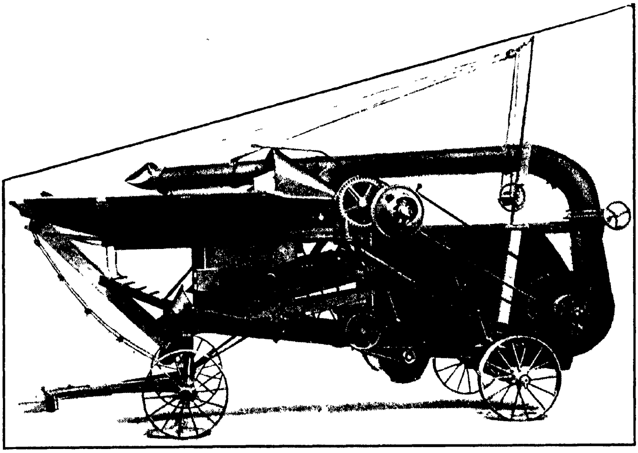


FIG. 231.—Side view of husker-shredder. (Independent snapping roll type.)

In such cases gravity does not aid the ears, but mechanical means are relied upon entirely to move them on these husking rolls.

In the machines having the Combination Husking and Snapping Rolls, they are usually set on an angle of about 15 degrees. The upper part, or about one-third of each set of rolls, acts as snapping rolls, while the lower part, or the other two-thirds, acts as the husking rolls. Sizes of husker-shredders are usually given in terms of husking roll. A two roll machine has two husking rolls; a four roll machine has four, and so on. The large sizes run as high as twelve. The number of

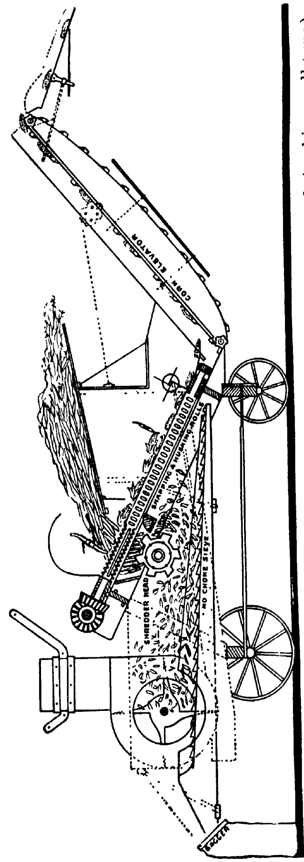


FIG. 232.—Sectional view of husker-shredder (combined snapping and husking roll-type).

snapping rolls has no bearing on the size rating, not even when they are a part of the husking rolls.

Field Operation.—The first thing to do is to get the machine properly blocked in position and the drive belt put on and running in the center of the pulley face and at the correct tension and proper speed to deliver all the tractor's available horse power. The main drive pulley is usually located on the shredding or cutting cylinder. The speed at which the shredding cylinder should run is usually stenciled on the pulley or on the frame of this machine. It is very important that this speed be obtained and steadily maintained. It will be found that the shredding-cylinder is usually run at about 1000 R.P.M. From this shaft the upper and lower snapping rolls, as well as the husking roll countershaft, are driven. Very often gears are used for this purpose. This, therefore, imparts a positive drive between these members. If the main drive pulley on the cylinder, therefore, runs at the correct speed, it follows that these other parts will also have a correct speed.

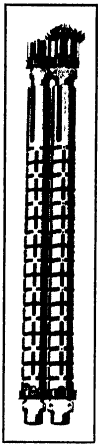


FIG. 233.—A pair of husking rolls.

On machines of the combination snapping and husking roll type, frequently the main drive pulley is located on the countershaft driving the rolls. On some machines of this type the drive belt may run over several pulleys, with a view to getting a positive drive on these parts. Idlers may be used to get a good wrap on these pulleys besides. On machines of this type a speed considerably below one thousand is common. Probably a speed of from 350 to 400 is more nearly correct for this husking roll countershaft. If this main drive belt should be run over on the shredding cylinder too, it will be speeded to about 1000 revolutions per minute by using a small pulley on this shaft

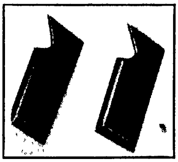


FIG. 234.—A husking pin.

as compared with a large one on the husking-roll countershaft. If belt drives are used instead of gears for driving some of these other shafts, it is equally important that they be kept tight so that correct speeds of all parts may be maintained. Correct speeds of various parts on these machines, as on any other farm machine, is an important factor to their successful performance.

The Snapping Rolls, which are always in pairs, should have the proper spring pressure so that the cornstalks may be

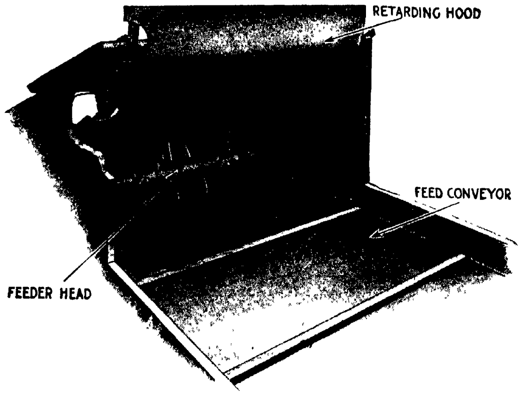


FIG. 235.—Feeding device and snapping rolls of conventional machine.

drawn in and the ears snapped off. Very often it will be found that this pressure adjustment is too tight. The result is that the roll will not take the corn. The operator will describe this as "having no draw." The solution is—released tension. This is an important adjustment. In corn that is damp, particularly when shredding corn which is being hauled from a field in the late fall or early winter, when there has been a wet season or even with snow and ice on the stalks, it will be found advisable to adjust these springs to get the proper "draw" for capacity work. When the spring tension is too loose no such

trouble will result; but in such cases, particularly in very dry corn, the snapping operation is bad, and many ears go through the rolls instead of being snapped off. In fact, a machine is usually "plugged" very easily when this tension is too loose. A broken spring will sometimes be found causing this trouble. At any rate, this spring pressure should be adjusted to suit the condition of the material being handled so that the maximum efficiency may be obtained. Care should be used to adjust both sides with equal pressure.

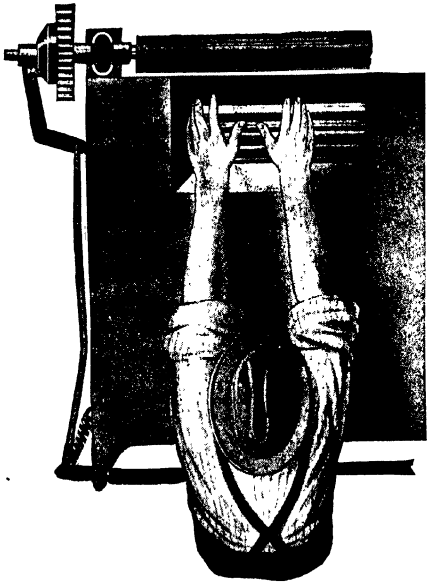


FIG. 236.—Safety device showing the operator out of reach of the snapping rolls. Clutch throw-out lever in front of feed table.

Never use any more spring pressure on these snapping rolls than is absolutely necessary to do a thorough job of snapping the ears from the stalks.

For different varieties of corn, or where the ears are small, it is often necessary to use snapping rolls of special design. For pop-corn, special rolls are usually necessary. These are not so vicious and do less damage to the corn; that is, fewer ears go through the snapping rolls, and less corn is shelled. It is often necessary, in order to get good "draw" on the snapping rolls, to "time" them properly. The grooved upper and lower rolls, so commonly used, should

be carefully timed with each other, which gives these rolls a large grip opening. This means a good hold on the butt ends of the stalks and, therefore, a good "draw." Besides, such a timing tends to bend the stalk back and forth, which means better snapping of the ears from this stalk. Care should be

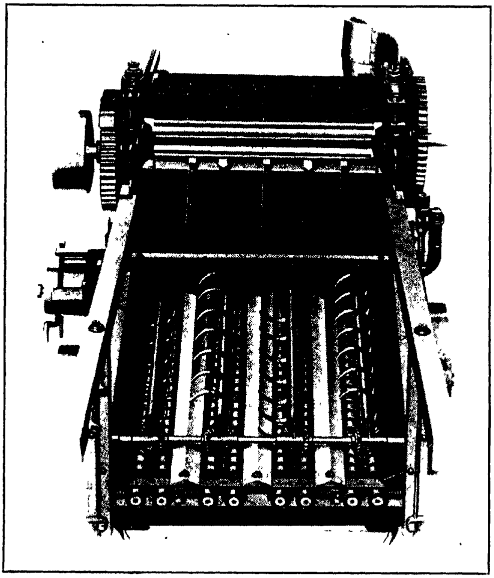


FIG. 237.—Front view of inside of machine showing husking-bed, snapping rolls and gearing.

exercised to see that the bumpers between the boxes are so set that the rolls do not quite touch each other. The smallest amount of clearance possible, about one-thirty second of an inch should be provided, but in no case should the rolls bang against each other, because they will be damaged.

Husking Rolls are always operated in pairs and are usually set with a fixed spring pressure. These rolls may be smooth or

nuted. In some cases one roll may have a steel blade like a knife, which corresponds with a groove or flute. In any case, the purpose of these rolls in sets of two is to remove the husks from the ears of corn. Where smooth rolls are used, husking pins are most generally provided, which are set to match with depression or holes on the opposite roll of the pair. These pins are small and should be kept sharp. If they get dull, they should be replaced or turned so the unworn or sharp edge will grip the husk, as the various designs call for. Sharp pins are absolutely necessary to do good work. In any case, the pins or flutes, whichever are used, should come together in pairs so that they get hold of the husks evenly instead of merely turning the ear over. This means that the husking rolls always should be run in "time" with each other.

It might happen that a piece of wood or stone would find its way to this "husking bed," as the entire set of husking rolls is termed, and in passing through between them, force them far enough apart to cause the gears which drives them to slip one tooth and get "out of time." This, therefore, should be closely watched and if it should happen, it would be necessary to reset and "time" properly. If they are of the type where "timing" makes no difference, care should be used, at any rate, to keep foreign substances, such as stones or pieces of wood, from reaching these husking rolls since there is danger of breaking them if forced too far apart.

Above the "husking bed" some means is usually provided to aid the work of the husking rolls. This mechanical device keeps the ears moving on the husking rolls so that they can properly do their work of husking. This device also tends to rotate the ears to present all of its surface for the husking rolls to remove the husks in a clean and satisfactory manner. A further purpose of this device is to get the ears properly distributed to this husking bed, and to keep the ears in their proper place. Often the ears tend to get stuck on these rolls. A further function of this device is to help prevent this, and keep the ears from clogging. This part of the machine has an

important part to perform. Therefore, it should receive every consideration.

Various devices are used to obtain the results sought. In nearly every case the entire mechanism used in aiding or assisting the work of the husking rolls may be set close to or away from these husking rolls, to suit various sizes of ears

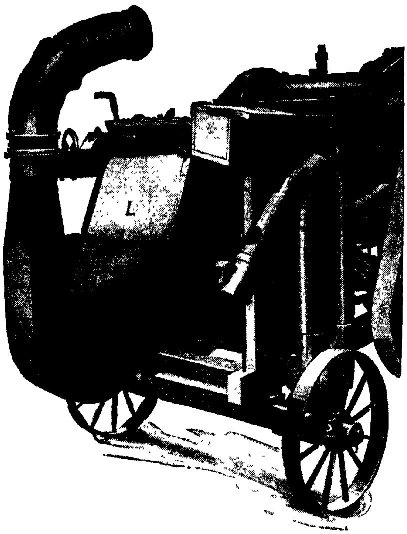


FIG. 238.—Blower and bagging elevator.

on the corn encountered. It is important, too, to be sure that the ears do not lodge on this husking bed, which makes for poor husking. It is equally important to keep them moving, else overloading is the result, which is also a bad feature that means poor work of husking.

NOTE—If clogging should occur, at the husking rolls, the operator of the husker-shredder, or any one else should in no case, attempt to use his hands to free these ears while the

machine is running. This is very dangerous and should be very carefully guarded against. This also applies to plugging or clogging at the snapping rolls. It should be a hard and fast rule of the owner of the machine to caution everybody working about the husker-shredder in this subject.

The Separating Device of the husker-shredder has an important function to perform. It is to separate the shelled corn from the stover, the cut or shredded stalks or leaves. This loose corn in the manger often causes the cattle, who are being fed on this material, to waste much of it in their eagerness to find these stray corn kernels which they relish very much. Added to this is the fact that this shelled corn can be used to better advantage for other animals, or as poultry feed.

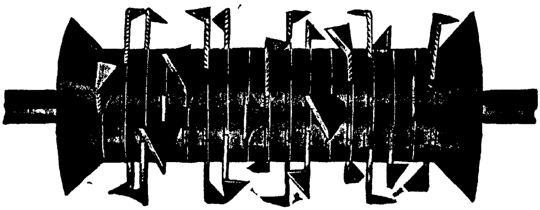


FIG. 239.—Combined cutting and shredding cylinder.

The adjustment of the clearing fan shutters to get this new shelled corn well cleaned needs attention. This can be done by carefully opening or closing the blinds on the outside of the cleaning fan drum. A screen is sometimes used in the shoe bottom to remove dirt and grit from the shelled corn. It often becomes plugged with the fine dust in this corn, and needs close watching. If there is snow or sleet on the corn being shredded, clogging of the screen in the shoe bottom is common. The ear elevator and spout, although very simple parts of this machine, need some care too, in order to avoid breakage. If belt-driven, these should be tight enough to do the work properly. If chains are used they should be set so they are not so loose as to climb the sprocket teeth and do some

damage. The bagging elevator, while very simple, also needs some attention so that the chains or belts, whichever are used, are each doing their work properly.

The Wind Stacker or Blower on a husker-shredder needs great care in order to obtain maximum results. The end of the pipe, or chute, of this blower is usually put through a door in the barn to deliver the stover into the mow. Often during the day it is well to get into the mow to be sure that the stover has not accumulated at the end of this pipe. If it does this, there is sure to be a plugged blower pipe. Plenty of clearance must be allowed at the end of this pipe so that plugging will not occur. While it is not apt to do any serious damage if noticed soon enough, it causes a delay to clean out, and all delays of any sort are aggravating. If a little caution is exercised, therefore, to keep plenty clearance at the end of this blower pipe in the mow, no trouble will be encountered. What has been said on this subject in the paragraph on Threshing Machines will apply here, also.

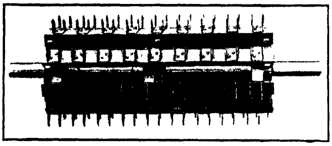


FIG. 240.—Shredding cylinder.

Lubrication of a husker-shredder needs particular attention. Being used in the late fall or early winter when the weather is cold means that lubricating oils and greases congeal very rapidly and often, although a bearing oil-well has been filled recently, it may heat and burn out the babbitt before the oil has become fluid enough to do any good. To begin with, the lubricating oil used should be light enough to flow and yet have body enough to support the parts being lubricated. When the steam tractors were common, it was comparatively easy to keep the oil hot by keeping one of the oil cans continually on the hot boiler, while the other was in use. With the modern gas tractor, however, as the power medium, no such heating places are available, but in any event it is ad-

visable to use two oil cans alternately, keeping one in a warm place on the tractor engine to keep the oil warm and fluid so that it will flow more easily and reach the bearing to be lubricated. Some oils are obtainable that are not so readily effected by lower temperatures as others and high grades of such oils may be used.

The shredding cylinder has a high rotative speed and needs special attention. The main drive pulley, located on this shaft,

FIG. 241.—A typical husker-shredder field scene.

brings the drive belt tension in this shaft, and its bearings, which means that lubrication should be very thorough and very carefully attended to at all times. A medium light oil, applied frequently and in small quantities will do more good than filling the oil wells full at long intervals of time. A good grease, too, may be used if the bearing is provided with compression grease cups, but even this necessitates careful and particularly frequent attention by turning these grease cups down often during the run to get uninterrupted service from the machine.

The snapping rolls, while not being a high speed part, have very heavy loads. This means that lubrication needs attention. The same thing is true of the husking rolls. These parts should be oiled with a small amount of lubricant which should be applied very often. Neglect will cause a heated bearing. It may even melt the babbit out completely, which would be more serious. The blower fan shaft, when oiled, should rather get less oil at a time, but the number of oilings should be increased in proportion. In other words, oil a little each time, but oil often. (The chapter on "Lubricating Oils" will give additional information.)

Capacity.—Like that of threshers, the capacity of huskers is given in bushels of ear corn, or baskets, as is usually the case, that may be husked per hour. Here, too, like threshing, it is easily seen that it is really a question of yield of the corn per acre that would influence the capacity. The approximate figure for capacity based on average corn yields per acre which may be used per set of husking rolls is twenty baskets (bushel size) of husked ear corn for each set of husking rolls per hour. Actual capacity depends, first of all, on the yield, then on adjustments of parts, and on the type machine used and the condition of the corn being husked.

Machines that have the combination snapping and husking rolls in the larger sizes usually have a greater capacity per unit of width than the other type. In fact, a large eight roll of this type has the capacity of a ten or twelve-roll of the other type. This is easily understood since such a great snapping roll area is presented to the incoming mass of corn as compared with the single set of snapping rolls. To offset this, however, is the fact that this type machine usually does not do so good and clean a job of husking. It often shells considerably more corn, too. This is due to the fact that as the upper or snapping end of the rolls is opened to let stalks and leaves through in such great quantities, the lower or husking ends of the rolls are farther apart than usual, which accounts for the lower grade work of husking and often excess shelling.

The following table gives figures on capacities of husker-shredders under favorable conditions of corn and with good average yields:

SIZE MACHINE	CAPACITY PER HOUR IN BUSHELS
2 roll	15–20
4 "	22–40
6 "	35–60
8 "	45–80
10 "	70–100
12 "	80–120

Power Required.—The work of husking-shredding like threshing requires a great deal of power and of a steady uniform kind. When these machines were operated by steam tractors there was usually plenty of available power and often a surplus. The selection of a husker-shredder should, therefore, be in accordance with the power which will be available.

The following table will give approximate figure of power requirements for husker-shredders of different sizes and is based on corn in good condition and of average yields and average length:

SIZE MACHINE	HORSE-POWER REQUIRED
2 roll	5–10
4 "	10–15
6 "	15–20
8 "	20–25
10 "	25–30
12 "	30–40

Combination Machines

The term "Combination Machines" refers to husker-shredders that are used for silo filling. These machines are often termed "husker silo-fillers." The material handled is usually shocked corn. Tests have proven that by adding sufficient water corn in this stage makes fairly good silage if properly put up.

The first change that is embodied is that the cylinder is usually a knife wheel cutter, instead of a shredding cylinder. Means are provided for snapping a part of the ears from the corn stalks and husking them in the usual manner. The balance are put thru with the stalks and go to make the silage. Snapping rolls of different kinds may be used that vary the percentage of corn that is snapped. Means are also provided for conveying all shelled corn in with the silage.

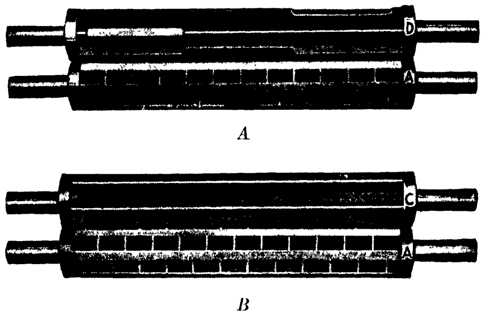


FIG. 242.—Snapping rolls on combination machines. *A* put about 50% of the ears in the silo, *B* about 30%.

Additional lengths of blower pipe may be procured that permit blowing to the top of the silo. Deflector hoods or elbows for the upper end may be used on such machines. This change makes a two purpose machine and enables a farmer to change over from one to the other within a short time. The general outside appearance and driving mechanisms are usually undisturbed.

The power required is approximately the same as listed in the table for work with husker-shredders. The capacity as silo filling machine may be read in tons per day, instead of bushels per hour as indicated on the table shown above.

CHAPTER XXII

CLOVER HULLERS

Function.—There are from fifteen to eighteen million seeds in a bushel of clover or alfalfa, and to get these out of the heads or seed pods and free from dirt and foul seeds is the work of the huller. Clover hullers have many things in common with threshing machines; it might even be said that they are threshers. Extra parts called "clover hulling attachments" are available for practically all threshing machines on the market. These are only partly successful in doing the work of clover or alfalta hulling. To hull and clean clover or alfalfa seed properly necessitates running it through a special machine called a "huller." The purpose, of course, is to remove the seeds from the head and separate them thoroughly from the stems, broken leaves, etc.

Sizes, Types, and Rating.—Clover hullers are usually made in a very limited number of sizes and are rated like threshing machinery—that is, width of cylinder and width of rear. Many manufacturers give their machines a common term such as "Special," "Regular" or "Standard," etc. Others use the size such as a "40-60" or a "30-50." The cylinder in such cases is the small dimension and the rear of the machine is the larger dimension. All hullers are practically alike. They are not usually made in great quantities like threshing machines, yet their importance in agriculture is never questioned. Practically all hullers are similar in that they have a stemming cylinder and a hulling cylinder; all have separating devices, a shoe, and most of them an auxiliary cleaning attachment.

Field Operation.—The clover must be in the proper physical condition for good hulling. It must be very dry. Hulling

is done late in the season, and if the work is done early in the morning there will be considerable dampness in the material to be handled because the moisture of the night is on it. Exposure to the sun a few hours in the morning will usually dry it sufficiently to make it ready for the machine. Clover hulling should therefore be started late in the day, and on a bright dry day, to get the best results from the machine.

The discussion of threshing machinery and the method of setting and belting will hold good for clover hullers. It is important to guard against over-feeding the machine. Material must be fed to the huller very carefully and uniformly.

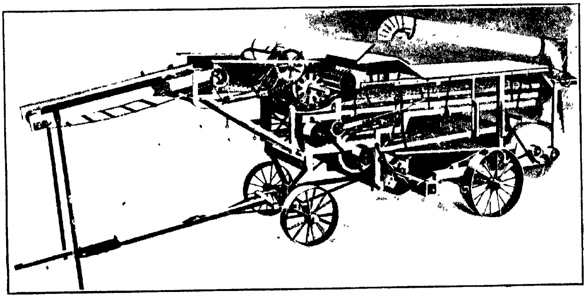


FIG. 243.—A skeleton view of a clover huller.

The stemming cylinder, like that of the threshing machine cylinder, has spikes or teeth which pass between a series of stationary teeth in the concave. These cylinder and concave teeth remove the heads or pods from the stems. This represents the principal work in hulling. The teeth should run very close to each other, and, like the thresher, should be adjusted so that they travel exactly midway between the concave teeth. This means that they should be evenly spaced to get the best results from the machine. As in threshing, it is advisable to use as few teeth in the concave as will do good work. The fewer that are used consistently with the work done, the easier will be the work on the separating racks,

because less small straw and chaff will have to be handled. The material passes under a beater and over a separating table of coarse mesh. The coarse material, such as stems, leaves, etc., goes out at the rear end. The threshed loose seed and the pod in which the seed is held fall through and are carried forward on a rack called a return pan or return table. This work of separating is done by a close and fine mesh rack. Some machines have two, others only one. This threshed material, going forward, is fed into the hulling cylinder, which is usually some eighteen or twenty inches in diameter, and the full width of the machine. It is ordinarily covered with some coarse material like a rasp, or filled with hundreds of small steel pins to get a rasping or rubbing action. It runs about 800 R.P.M., depending on the diameter, and very close to concaves, usually made of wood, and covered with this same rasp material. It can readily be understood, therefore, that the seeds in the pods, coming to this rasping cylinder and having to travel between it and the concave, are rubbed violently between these rasps, and the small cover or alfalfa seeds are removed from the pods in a very thorough mnaner.

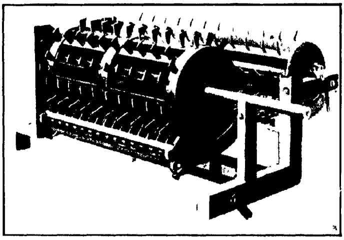


FIG. 244.—A stemming cylinder with concaves and beater.

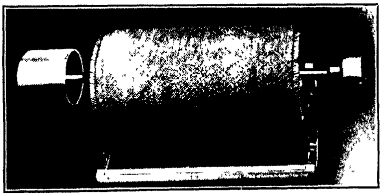


FIG. 245.—The hulling cylinder and concaves.

It is very necessary that the adjustment of this concave to the hulling cylinder be made carefully. The quality of

work done is largely affected by this adjustment, and it should, therefore, be watched very closely. These concaves are usually adjusted at the front and rear, and it is good practice to set the front end—that is, the end where the material is fed into the huller cylinder—a trifle wider than the rear. This permits of more capacity and better work. It gives the hulling cylinder what is commonly termed "draw." The material from here passes over a chaffer, the heavier material going out into the wind stacker and the fine seeds drop through this chaffer to the shoe. The work here is similar to that of the threshing machine. A tailings-elevator, similar to that used on the thresher, moves the coarser material forward to the hulling cylinder to be re-hulled and the clean grain is elevated to the re-cleaner.

Fig. 246.—One type of rasp used on hulling cylinder and concaves.

The re-cleaner contains a small shoe and a fan, and these seeds pass over a series of riddles of fine wire mesh or perforated metal. The blast from the fan, acting on the seeds, removes the dirt, that is, the coarse dirt that is lighter than the seeds. The seeds then travel over a screen, usually of wire mesh. through which sand and other heavy foreign material pass by gravity. The seeds are then delivered, thoroughly cleaned, to a bagging attachment and put into sacks ready for the market. The method of setting the sieves in a thresher for cleaning grain applies to hullers also. The setting of the re-cleaner is comparatively simple. It is largely a question of getting the proper wind adjustment to do the work thoroughly. The

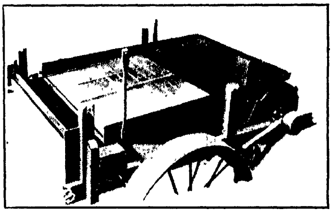


Fig. 247.—Cleaning shoe (note fine sieves).

selection of one or another of the various screens for this re-cleaner depends on the seed that is to be handled.

Also the discussion under the heading of "Threshing," relating to proper speeds, the handling of the various belts, and the feeding, will apply here. The wind stacker used on the huller is identical with that used on the thresher.

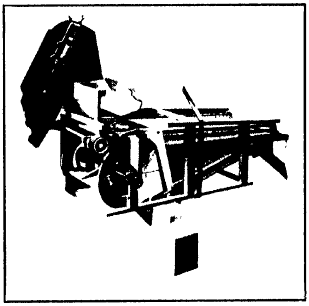


FIG. 248.—Skeleton view of a re-cleaner.

It is a good plan, at the end of the day's run, to clean the inside of the machine thoroughly by running it quite awhile after feeding has stopped. The fine seed, dust, etc., accumulates moisture from the night air and if left in the machine, will settle or stick to the grain pan or to sieves and screens, and interfere seriously with good work the following morning. A canvas cover or tarpaulin to spread over the entire huller every evening will prove a good investment.

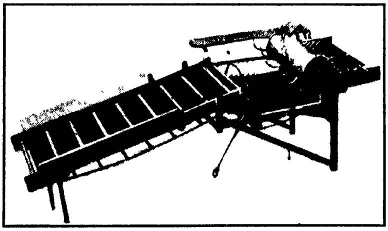


FIG. 249.—A feeder for a huller.

Capacity. — The huller capacity figure, unlike thresher capacities, is low. The difficulties of hulling which make this so are the smallness of the seeds and the fact that it is hard to remove them from the bolls; and furthermore, the machine may be run for only a few hours each day. In general, a 30- or 32-inch huller under favorable conditions of the clover or alfalfa and of average yield, from 10 to 15

bushels of seed may be hulled per hour. A good average rate of hulling for a 34- to 36-inch machine is from 12 to 18 bushels per hour.

Power Required.—Hulling clover requires slightly less power than is required for running a thresher of the same size. The table given above on the power required in operating threshing machines will apply equally well to hullers. Under good conditions it would be safe to select the minimum figure of power requirements.

CHAPTER XXIII

PEA AND BEAN THRESHERS

Function.—The purpose of these machines is to remove the various kinds of peas and beans from the vine and the pod. This work is frequently done by a grain-threshing machine with the necessary attachments, which does the work fairly well, without injuring the peas or beans. More often a regular pea and bean thresher, made specially for this work, is used; particularly so in localities where great quantities are grown. In such localities these machines are often termed "beaners." The different varieties of peas and beans call for a variety of sieves and adjustments to clean them properly; it is merely a question of getting the correct combination of parts to bring this about.

Types, Sizes, and Rating.—In localities where peas and beans are grown in quantities, it is best to secure a machine built especially for this purpose. These machines usually have two threshing cylinders; some have three. In localities where this crop is a side issue, and grain the main issue, attachments to the ordinary grain thresher will do very well. Since the working parts of pea and bean threshers are similar to those of a grain threshing machine, it will be found that the rating of sizes are the same as those of threshing machines, which is explained in the paragraph on this subject in Chapter XVIII.

Field Operation.—The operation of these machines is exactly the same as that given in the chapter on threshing machinery. Peas and beans are far more brittle than grain and much more difficult to handle, to say nothing about the

differences in size and, consequently, the speed of the cylinder must vary materially.

The distance between the cylinder and concave teeth must be much greater than on machines used for threshing small grains. If not, the peas or beans will be broken or the outer skins injured or damaged, which will grade them very low on the market.

The speed at which the cylinder should run, like that of the grain thresher, depends on the diameter of the same. It is usually stenciled or printed somewhere on the side of

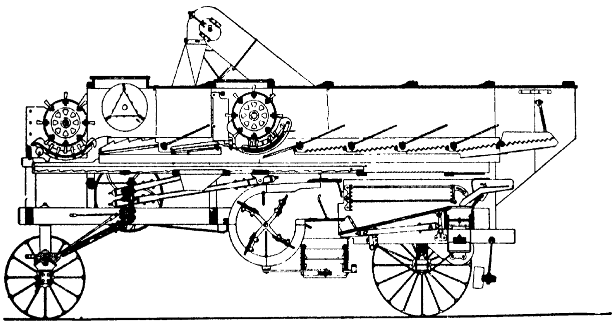


Fig. 250.—Sectional view of a bean thresher showing both cylinders.

the machine, and it is necessary that this be very closely watched and kept uniform. In any event, it will be somewhere near one-half as much as for grain. On machines using a large diameter, a speed of about 360 R.P.M. to those of a small diameter running about 550 R.P.M., the peripheral speed is practically the same in all cases for the same work. In other words, like grain threshers, it is uniform. It may be increased when the peas or beans are very hard, like the garbanza bean, or reduced if the opposite condition is found, as will be the case when threshing white navy beans.

The operation of threshing machinery, with reference to

adjustment of concave sieves, etc., will also apply to machines handling peas or beans.

Breakages run the grade down very rapidly, and since it is desirable to deliver peas and beans undamaged to the sacks, they should be whole and not split. The tailings-elevator and the auger usually work without doing any damage, yet if not properly adjusted, the tailings-elevator and even the weighing or bagging elevator may damage some varieties of peas and beans, and if the elevator chains are too slack, this is more likely to happen than if they are tight.

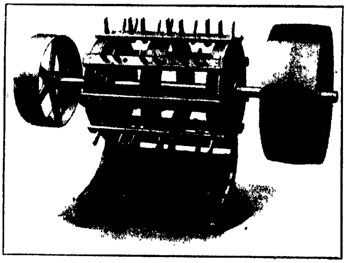


FIG. 251.—Cylinder and concaves for pea and bean threshing. (Note wide spacing of teeth and large pulleys.)

Cleaning peas or beans is a comparatively simple task, which merely requires a chaffer sieve and a shoe sieve of the proper size. When threshing small peas, the adjustable sieve that is used in threshing grain will be found satisfactory if opened very wide. This also holds true in some of the smaller varieties of beans. Where large peas or beans, such as horse beans, are threshed, a special chaffer and sieve, preferably of the lip type, should be used to let them pass through it, otherwise serious wastage may result. It is also a good plan to use a screen at the bottom of the shoe to remove all dirt and foreign substances which always find their way through the machine to this place.

Since the work of threshing peas and beans is very dirty and dusty, particular attention must be paid to keeping the bearings free from grit and to keep the oil wells covered and apply a lubricating oil very freely to the cylinders, the cleaning fan, the wind stacker, and the shaker cranks. Because the beans are threshed directly after they come from the

ground where they have been dried, there is always an accumulation of dirt. More than this, the dirt usually hardens on beans in lumps and in going through the machine it breaks up. Peas and beans grow best in sandy soil, and sandy soil will ruin a bearing more quickly than any other kind, for it is practically all grit. Wherever possible, it is a good plan to use an exhaust fan—which is nothing more or less than a suction fan placed on the deck of the machine—which will remove most of this dirt and dust, taking it from behind the cylinder and delivering it through a long cloth tube to the rear of the straw pile. This will help make the work around the machine much more agreeable for all concerned. Such a suction fan may be a part of the regular machine or it may be purchased as an extra, but in either case it is a valuable part of a bean or pea thresher.

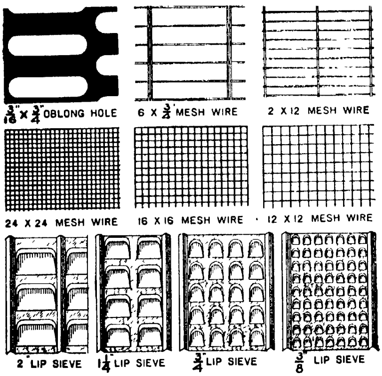


FIG. 252.—Sieves and screens for pea and bean machines.

Oiling the machine like a thresher is important. The two or three cylinders and the wind stacker, if used, should be oiled every few hours throughout the day. The suction fan and cleaning fan, too, should get the same attention and just as often. It is desirable to oil a pea and bean thresher even more often than a grain thresher because the dust and dirt about the machine if it got into a bearing is far more dangerous because of its gritty nature.

Capacity.—The capacity of pea and bean machines is much less than that of grain threshers. Their capacity rating will

vary with the different kinds and varieties of peas and beans that are being handled and with various sizes of machines. In general, it is reasonable to expect less because of the reduced cylinder speeds. An ordinary 24-inch bean machine should be able to thresh and clean from 35 to 50 bushels of peas or beans an hour and do a thoroughly good job. White navy beans, if brittle, must be handled more slowly, whereas peas, if a hard variety and very dry, may be put through the machine at higher speeds. Regular grain threshers provided with attachments for threshing peas and beans will have about one-half the capacity of a regular bean thresher of equal size.

Power Required.—The power required to handle peas and beans is slightly less than that for threshing dry oats. It is safe to take from 15 to 20 percent less than the minimum figures given for the power required to run grain threshers. Regular grain threshers handling peas and beans will require about one-half the power that is required for threshing grain even at its best.

CHAPTER XXIV

FEED GRINDERS

Function.—The purpose of these machines, which are often termed "feed mills," is to grind various grains into feed for cattle and stock. It may be either shelled corn, husked or picked corn, kaffir, corn, beans, peas or pea vines, peanut hay, or any roughage requiring grinding into various degrees of fineness to meet conditions. The machines should be able to grind any of these materials or any combination of them with a minimum amount of power, and to the required degree of fineness with the least trouble and in the shortest possible time. This machine should have capacity in proportion to the power which is available and the degree of fineness ground.

Types, Sizes, and Rating.—There are several types of so-called grinders. "Feed Grinders" grind feed for stock, on the farm. For this purpose there are two distinct types. One is a machine used for grinding small grains or corn only, and the other is for cutting and grinding roughage and grains together. In the latter type, a mechanism is provided which cuts roughage, such as cornstalks, hay or other material, into small bits before it is introduced to the grinding plates, alone or in combination with small grain. These two types cover practically the entire range of feed grinders which would be used in combination with a tractor for farm work.

These machines are rated in sizes according to the diameter of the grinding plates. For instance, a 10-inch machine would have plates 10 inch in diameter, a 12-inch machine would have plates 12 inches in diameter, etc. These grinding plates are often referred to as buhrs. Combination cutters and grinders usually have a cutting mechanism with sufficient

capacity to suit the size grinding plates which are used. The selection of one or another, with reference to size, should be based on the power available and the amount of stock to be fed.

Operation.—It should be set low enough so that it is convenient to pitch or shovel into the hopper and should be provided with facilities to use with the tractor, that is, with the belt pulley of the proper diameter so that it can be belted conveniently. The operation of these machines, so far as belting is concerned, is similar to that of any belted machine. They must be properly secured to the floor of the barn or granery where the grinding is done; or else securely fastened to some liberal sized skids, so that they, in turn, may be staked to the ground if grinding is done where no floor is available. When starting a new machine, it is important that the plates be well separated; in other words, that there is plenty of clearance between them. All machines have an adjustment between the plates, governed by a screw, by which very close regulation can be procured. This screw, in most cases, works against a spring. This spring will compress if foreign material of some sort gets into the grinding plates and will, therefore, avoid breakage and serious damage. An auxiliary hand lever, operating a cam, is also provided on nearly all machines so that the operator can instantly release the plates when necessary. This lever can also be thrown back to the

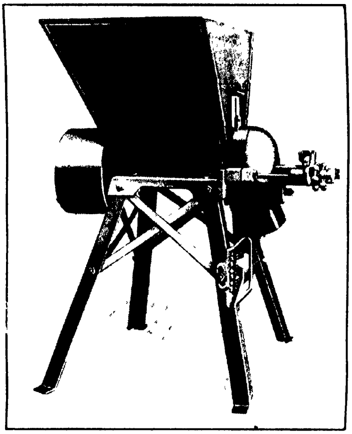


FIG. 253.—Common feed grinder.

original position which means that the original adjustment is procured after the plates have cleared themselves. These are preliminary adjustments which should be made to become familiar with the machine and to get material ground to the proper fineness.

No particular figure can be given for the proper speed at which these machines should run. Unlike most other farm machines, they do not have a critical speed at which it is necessary to operate them. It, however, should be the aim of the owner to run them no less than about 400 R.P.M., and in no case should the speed exceed 1000; in fact, about 800 R.P.M., is fast enough for all ordinary conditions. It must be borne in mind that the capacity is, in a measure, in proportion to the speed.

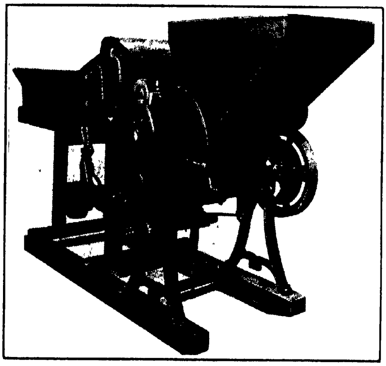


FIG. 254.—Combination roughage cutter and grinder.

Most manufacturers furnish an extra set of plates with each machine and sometimes an extra set of breakers or crushers. Plates to suit the grinding of different degrees of fineness are available and may be selected to suit the conditions under which the machine is to work. It is a good scheme never to grind the material any finer than is necessary to get the results in feeding which are desirable. Finer grinding takes power and is slow work.

It must be understood that these machines are to be oiled very thoroughly. Particular attention must be paid to the bearing next to the drive pulley because it carries the belt tension of the main drive belt besides the regular load im-

posed upon it in the grinding. If, as is often the case, a little grinding is done every day, or twice or three times a week, care should be exercised to oil all the bearings with a good grade of lubricant each time before starting and often during the run.

In feeding these machines, the operator should be sure that no foreign material gets into the hopper. Small pieces of wood and stones find their way into the feeding hopper with the material being handled. Sometimes even a stray bolt or a nut will be fed to the hopper; and these foreign substances are in turn delivered to the grinding plates, and may do serious damage, if they are large enough and if the compression spring is screwed down so tight that the plates will not have leeway enough to let this foreign substance through between them. On most grinders the bottom under the crusher or breakers, the "concave," as it is commonly termed, is provided with wood break pins. Large pieces of foreign materials, therefore, should cause enough extra load to come on this concave to shear these wood pins, allowing the bottom to drop and this material to fall on the ground. Care should always be used to replace these pins with new ones made of wood. In no case should iron be used. The main shaft may be badly bent and, in fact, the concave broken, and in some cases the machine so badly wrecked that it is beyond repair if a foreign substance gets into this machine where a bolt is used instead of the wood shear pin.

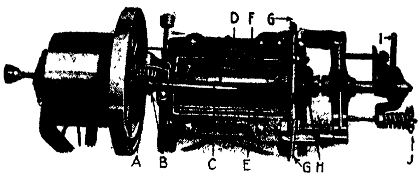


FIG. 255.—Crushing and grinding device of feed grinder: *A*, Flywheel; *B*, Agitator drive; *C*, Agitator; *D*, Crusher; *E*, Concave; *G*, Shut-off; *H*, Revolving plates; *I*, Release lever; *L*, Pressure spring.

The operator should accustom himself to keeping his ears

well "peeled" for strange noises about the machine. Foreign substances getting in between the crusher and concave, or even between the plats, will instantly make a racket that tells of trouble. In such cases the little release lever, mentioned above, which operates the cam, should be thrown over, which instantly releases the plates and allows this foreign material to pass through, before serious damage is done.

On those combination machines which have separate cutting mechanisms for grinding cornstalks and other roughage, together with small grains, the same amount of care should be exercised in keeping foreign materials from reaching these cutting knives. Since knives are actually used to cut this roughage, and since they travel close to a shear plate, it is very important that they be set close enough to the shear plate to cut well without actually touching it. A clearance about the thickness of a piece of thin cardboard will be sufficient for running, and yet the cutting will be done thoroughly and with the least amount of power. It must, of course, be understood that these knives should be sharp, and in cases where much cutting is done, and they lose their edge, they should be reground. The operator should never attempt to cut with dull knives. This is particularly true of dry material. When material is damp, it cuts more easily, but it is important to avoid grinding wet or damp material of any sort unless it is to be used for feed immediately. No amount of damp

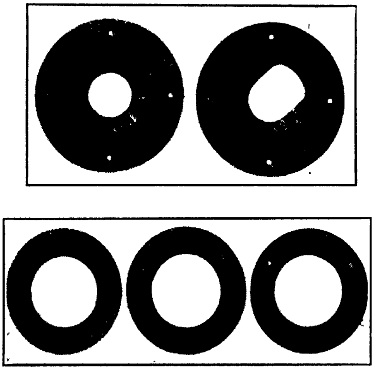


FIG. 256.—Grinding plates. (Note different types.)

material should ever be ground up, for more than a day or two in advance. It will mildew and spoil. In any case, grinding material for more than two or three days ahead is poor policy since these materials keep much better in the original state than when ground.

FIG. 257.—Feed grinder with bagging device.

When this roughage is fed, butts should usually be fed first and the hopper should be kept full continually, to get good results. To run a machine alternately empty and full is not alone hard on the engine or tractor driving it, but equally bad on the machine and the quality of work that it does.

Where large tractors are belted to relatively small grinders, it is a pretty easy matter to over-work the grinder. Care

should be had to see that the grinder is kept full, but not overworked because this induces stress and strain on the machine which may damage it seriously. In no case should the operator try to get the capacity of a 10-inch machine from one with 6-inch plates. The best thing to do to get a little more capacity is to bring the speed of the grinder up, and if this speed is up, the operator must never force the material into the hopper by crowding.

The grinding plates are usually made of cast iron with a chilled surface, which is very hard. It is really a glass hard-

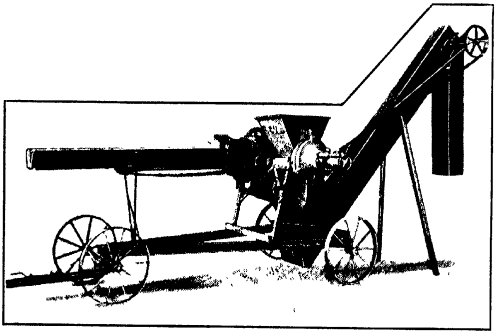


FIG. 258.—Portable combination machine.

ness and these plates grind by rubbing the material between them. Much care is needed in bolting them into place on the machine. The stationary plate should be free on its backing so that it will align itself and run parallel with the revolving plate. If, for any reason, this plate seems to rub at a certain place in the revolution of the revolving plate, it should be removed and an examination made to be sure that there is nothing in the way that hinders this plate from aligning itself to operate properly.

Various types of cob breakers are also furnished for these machines. The selection of one or the other depends on the

material which is to be handled. Care should be used in removing them to be sure that they are always securely fastened to the shaft.

The amount of material these machines will handle and grind well can be regulated by the gate on the hopper of the machine. This gate governs the amount of material that enters the grinding plates. This gate should be set so that the maximum of material is fed through the machine consistent with the power. In other words, by grinding more slowly it is possible to grind finer than by forcing the material through or crowding it. It is also important sometimes, when tractors of small horse power are being used, to use this lever to throttle the amount of material going through the machine. This refers particularly to grinding grain where there is a chance of putting too much through for the power that is available. Agitators are also provided in the hoppers of many of these machines which keep the material moving. Frequently, when the machine does not deliver the material at the outlet spout, it may be due to the fact that the hopper is plugged, which, in turn, may be because the agitator has become disconnected or broken. This agitator is of particular advantage when grinding roughage which has a tendency to bridge across the hopper and will not, therefore, work down into the spiral crusher.

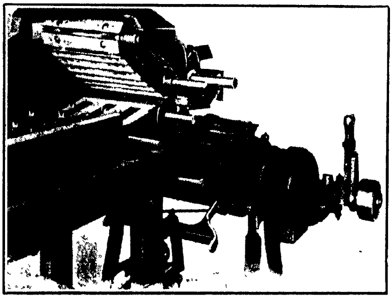


FIG. 259.—Feeding device of combination machine.

Attachments.—The most common attachment for grinders is an elevator which is usually driven from the main shaft by a small pulley and a two or two and one-half inch belt. This elevator is sometimes very long and provided with a spout to

deliver into a wagon box; or a short elevator may be provided with a bagging spout which will deliver the ground material into sacks. The choice of one or the other depends on the disposition that is to be made of the ground material and the amount of material being ground.

These elevators require very little care other than keeping the belt tight and the bearings oiled. Of course, the upper bearing should be adjusted so that the conveyor on the inside

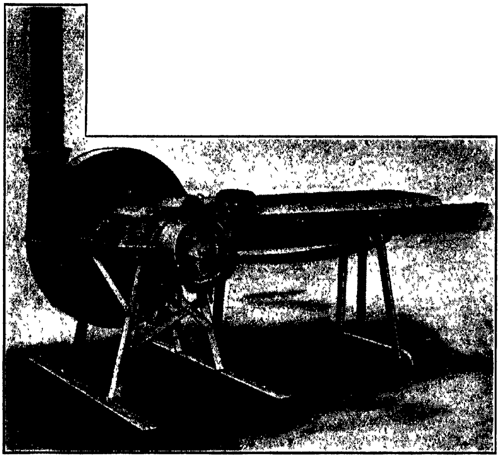


FIG. 260.—Combination grinder and cutter with blowing device.

will lift the ground material. If a chain is used, the adjustment must be such that there is no danger of its becoming unhooked because it is too loose. Neither should it be so tight as to cause unnecessary stresses on the bearings or chain.

Capacity.—The capacity of these various machines is in proportion to the power available and the speed at which the grinding plates are operated, together with the degree of fineness which is desired. The hopper, in most cases, is in proportion to the size of these plates.

The following table is an approximation of the capacities of machines of this sort. It may be seen that the capacity is in proportion, in a measure, to the power which is being used to drive the machine. The speed at which these machines run has a decided influence on the capacity. The capacity is also further influenced by the degree of fineness to which the material is being ground. The figures given, however, cover average conditions with plates which are usually furnished with these machines when sent from the factory.

SIZE GRINDER	R.P.M.	CAPACITY PER HOUR BUSHELS	APPROXIMATE POWER REQUIRED
6 inches	400	8–16	4 H.P.
	500	10–20	5
	700	16–32	6
	900	20–40	8
8 inches	500	16–32	6 H.P.
	600	20–40	8
	800	28–56	12
	900	30–60	14
10 inches	500	20–40	8 H.P.
	600	28–56	12
	700	36–72	16
	800	40–80	18
12 inches	500	36–72	16 H.P.
	600	40–80	18
	700	44–88	24
	800	48–96	30

The capacity in corn or kaffir of a combination roughage cutter and grinder will be from 40 to 60 bushels per hour or from 1800 to 2400 pounds ground medium with 8- or 10-inch buhrs at speeds of from 750 to 950 R.P.M. Hay may be handled at a figure of from 3 to 5 tons per day of 10 hours at this same speed range.

Power Required.—The table above also shows the approximate power required to operate these machines and is based on grinding to the capacity figures listed, and at the speeds given. Variations, of course, depend on the kind of material being

handled, and the fineness to which it is ground, which also will influence the power. This table, however, covers average conditions and may be used as a basis for selecting machines to go with the tractor or any engine of a horse power indicated. Combination cutters and grinders require more power since the roughage require cutting before it reaches the grinding buhrs. A machine of this sort with 8-inch buhrs will require from 12 to 18 horse power at a speed of from 700 to 900 R.P.M. One with 10-inch buhrs from 20 to 25 horse power at a speed of from 700 to 900 R.P.M.

Feed Cutters

Function.—This machine is only a cutting mechanism and cannot be used for grinding. It may be used for cutting corn, hay, straw, etc. In some sections of the East and South it is termed a "cutting box."

Types and Sizes.—Like silage cutters, these machines are made in two types—the flywheel and the cylinder. These machines are generally rated in sizes which represent the width of the feed throat, such as a 6-inch and an 8-inch or a 10-inch machine.

Operation.—Since these machines are cutting devices, it means that work around them should be very carefully done to avoid accidents to the operator. Since they are belted machines, although requiring only a small amount of power, they should be properly secured to the barn floor and well belted. The speed at which a flywheel machine should run is usually given in the printed matter accompanying the machine. In no case should a speed of 650 R.P.M. be exceeded. Cylinder cutters should never be run in excess of 750 R.P.M. Extreme care should be used in feeding the material to the feed rolls not to crowd it at all. A slow, steady feed is desirable. Sharp knives are always necessary. Much of what has been said about the field operation of silage cutters will apply to these machines. The length the material is cut can be changed from about ¼ inch to 2 inches.

Capacity.—*The capacity* of these machines in general is from 900 to 1500 pounds of hay an hour for an 8-inch size, depending on the length of cut, the material being handled, and the steadiness of the feed. Large machines with regular feed aprons will cut from 1500 to 3000 pounds an hour.

Power.—*The power required* to run these machines varies from about 3 to 6 horse power for an 8-inch, while a 10-inch machine will require from 5 to 10 horse power. These are approximate figures because there are so many factors that enter into this problem that influence the power requirements.

CHAPTER XXV

WOOD SAWS

Function.—The purpose of these machines for farm use is to saw wood into boards or for fence posts or for fuel. These machines are made in many different types and sizes to suit the different uses. One type may be to cut small tree trunks into fence posts for which a pole saw would be used, or into cord or fire-wood, in which case a common sliding or swinging table saw would do. This is for cross cutting. If it is intended to cut timber into boards, a rip saw is necessary. Such farm sawing outfits, to be operated by tractors, are nearly always equipped with circular saws, and is commonly termed a "saw mill."

Types, Sizes, and Rating.—As mentioned above, there are a good many types of saws, and the illustration shows some of the various kinds. The sizes of these machines are usually designated by the saw diameter. Cross cut saws are usually 24 or 30 inches in diameter. Rip saws from 30 to 50 inches in diameter. For ordinary farm work, such as cutting wood for fuel or for fence posts, the type with the flywheel on separate counter shaft below the table will be found very practical.

Power drag saws are also obtainable but not so common as circular cross cut saws. Saw mills, which are used principally for ripping timber into boards, are growing less common since the local supply of available board timber is rapidly decreasing, or else it may be purchased at the dealers at a figure that makes sawing unnecessary. Large saw mills making a business of this work often turn out a better grade of lumber, and in some localities are able to furnish it just as

reasonably as farmers are able to cut it up from their own wood lot.

Field Operation.—The operator of a wood saw should realize first of all that this is a dangerous machine. Since he must work right in front of the cutting edge, it is well to use a great deal of caution so that neither he nor anybody working with him gets close enough to be involved in an accident that would result in the loss of a hand or even a finger. Small loose pieces coming in contact with the rapidly revolving saw blade are often thrown with sufficient force to do bodily hurt and therefore, some care should be used to keep such pieces away from the saw.

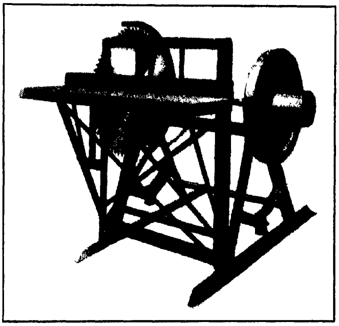


FIG. 261.—Common wood saw for sawing stove wood.

It is important that the saw should run at proper speed, which for cross cutting is approximately 9500 feet per minute. This is the speed or travel at the periphery or at the ends of the teeth of the saw. This means a speed of 1200 r.p.m. for a 30-inch saw, 1500 r.p.m. for a 24-inch and so on. Speeds for regular saw mills for ripping should be about 4000 feet per minute. Speeds for soft woods may be somewhat higher while for hard woods it should be reduced. The power available is a factor to consider. The diameter of the saw and the number of teeth must be considered. The machine must be well staked and securely held and be well belted. A belt of the correct width and sufficient length to pull the saw in question is necessary.

On the smaller type saws, such as the common wood saw, for individual use for cutting stove wood, or pole sawing, whichever may be done, it is necessary that the saw mandrel

run true. It should always be set level. Care should be taken in every case to see that this mandrel is kept true and that nothing is allowed to fall on it or in any way injure it as it is not possible to get satisfactory results from outfits with bent mandrels. On the small outfits that set out of doors most of the time, it is a good plan to remove the saw during that time when it is unused. It should be greased and hung in a dry place. The amount of work that saw mills or sawing outfits can do is in proportion to the sharpness of the edge that is kept on the teeth of the saws and the power available.

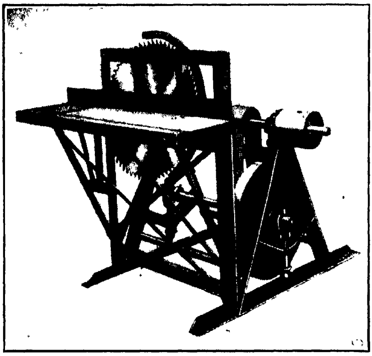


Fig. 262.—Wood saw for pole sawing. (Note countershaft and flywheel below table.)

To get good results from a regular saw mill the set-up must be correct. The machine must be properly staked to the ground and should be set level. The best place to level the machine is on the saw mandrel, and with the saw properly in place. By placing the level vertically on the saw itself, a check may be had on this leveling. To set the machine horizontally the carriage track timber will form a good foundation on which to level lengthwise. With the machine properly leveled, better work may be done.

A 48″ rip saw with 24 teeth should run about 350 revolutions per minute. As the number of teeth increases so should the speed and power increase. A 48-inch saw with 34 teeth should run at about 500 revolutions per minute. Larger saws should run more slowly, but in about the same proportion.

The carriage drive on these saw mills is usually friction and this should be carefully watched and kept clean. Grease or oil should never be allowed to accumulate on these friction surfaces. The gears driving this table should be kept well greased and the cables should be kept taut. Unless this is done, uniform operation cannot be maintained. The saw must be properly set. This must be watched very carefully to be sure that it does not rub so hard as to heat.

Some saws are equipped with stationary and others with revolving splitters. Where these are used and rotate, it is important that they should always work. If they refuse to turn, attention should be given to them before they heat rapidly and wear.

The mechanism for holding the logs, that is the "Dogs," as they are commonly called, should be kept sharp to get them to work well and the ratchets and dog shaft should always be kept properly greased to be sure they work uniformly. In other words, both must either back up and take hold, or let go of the log simultaneously.

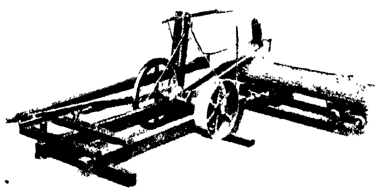


FIG. 263.—Drag saw.

All bearings must be kept well lubricated. All parts that move on one another should be kept well oiled. The saw arbor particularly should be frequently lubricated.

Saws.—Saws for ripping timber may be either of the right-hand or left-hand type. Standing in front of a circular saw with the top running toward you, it is a right-hand saw if the log passes on the right of the saw, and a left-hand saw if the log passes on the left of the saw. Usually in the manufacture of these saws they are marked with the words "Log Side" on the saw. Before placing a saw on the mandrel, therefore,

care should be taken to see that it is put on correctly. The name should be on the log side of the saw.

To sharpen a circular saw properly by hand is quite a task. Where they are made and in large mills where many are used, this is done on an automatic machine using grinding wheels. To do this work by hand requires much skill and great patience. Cross Cut saws and rip saws are sharpened differently. The illustration shows the difference in the teeth, and the correct shape to file the saw is one part of it. The teeth, to be properly filed, should always be square on the front or cutting side.

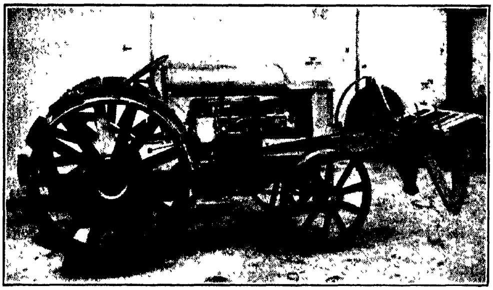


FIG. 264.—Wood-sawing attachment for a tractor.

In placing the cross cut saw on the mandrel, it is very important to see that the saw is free, that it is neither too tight nor too loose. The pins should have a free set also, and it should be unnecessary, in any case, to force the saw on this mandrel. The tight collar on the mandrel is usually concaved and the loose one perfectly flat. A rip saw should be very straight on the log side after the nut is screwed up tight, and the guide pins should be set so that they merely touch the saw lightly, and not so tight that they will form the guide for the saw blade itself. The guide pins keep the saw from "dodging." The saw is usually set so that it runs into the log rather

.than out of the log, and these guide pins should never b for this purpose.

If the saw has the proper tension and yet does not ru it is well to see that all the end play is out of the m itself and that this is not causing the trouble. Freq trouble is experienced from various sources and heati the rim is noticeable. Several things may cause this the saw has been filed with the backs of the teeth too or there may not be throat room enough for the sawc

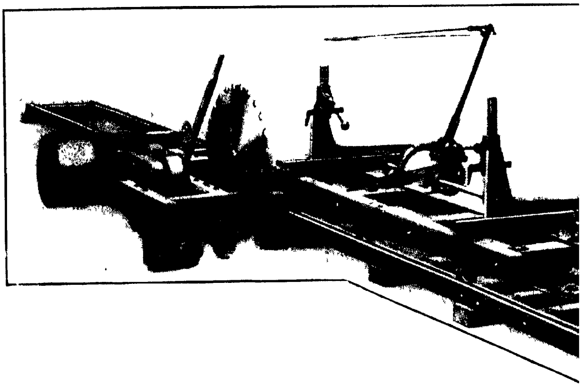


FIG. 265.—A right-hand saw mill. Saw has inserted teeth.

escape; the teeth may not be set enough, or the saw m be running fast enough to open up the body of the saw

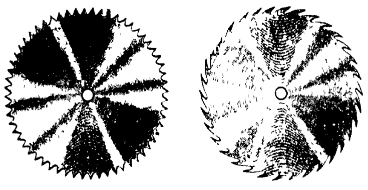
Saws often run warm at the center. This may be from a hot mandrel bearing itself, or the saw may be too much either to or from the log. Then again, the may be too low so that the saw hasn't expanded tl itself. A saw should run cool, and it should be unneces reset the saw due to these points. It is merely a ques adjustment.

Sometimes saws will tend to lead into or out of the log This can be overcome by beveling the backside of the

at the point. If the front of the tooth is square, and beveled at the back, this will cause the saw to lead into the log, and if beveled on the log side, it will lead the saw out of the log. Some saws run "snaky." This is usually due to the fact that the saw has been unevenly heated and should be re-hammered by an experienced man.

Filing.—If filing is attempted by the farmer, the following information may prove valuable:

It is a good plan to examine a new saw thoroughly when it is purchased and fix in mind the exact shape of the teeth and the way in which they are filed and set. Duplicating this filing and setting will prove very satisfactory. One of the chief difficulties in filing circular saws is that the bottom of the teeth are too often found with sharp corners instead of round. Cut-off saws may be filed a little beveled, or else the saw teeth will bend. This makes the outer edge cut more. A rip saw may be filed perfectly square and it is customary to file them from opposite sides. The teeth of all saws wear most at the extreme points, which do the work.



A *B*

Fig. 266.—*A*, Cross-cut saw; *B*, Rip saw.

Running a rip saw quite a time is apt to get it out of shape so that re-hammering may be necessary. This is a task for an expert and should not be attempted by the farmer. It would even be well to turn the sharpening of a circular saw over to an expert, because satisfactory results are obtained only when the work is done absolutely right. It hardly needs to be done more than once a year and is not an expensive operation. The average small portable cross-cut saw on the farm would hardly need sharpening more than every other year, and if nothing more was done than to cut up fire wood

for the winter, sharpening at longer intervals would probably be adequate if the saw was properly cared for during the idle period and properly run when at work. Uniformity in filing is one of the important things to watch. It is very important also to see that the saw is perfectly round. Since the very points in the teeth do the cutting, it is obvious that unless the saw is round, those teeth traveling in the largest circle will do the most work.

FIG. 267.—Saw mill.

Gages of Saws.—Saw blades are rated in gages which represent their thickness. A saw may be of a given diameter and termed an "8 x 9 gage," or an "8 x 10 gage." This means a thickness of 8 gage at the center and 9 gage at the rim. Usually a 7 x 8 or a 7 x 9 is the most practical for the ordinary saw mill since it requires great skill to operate the thinner gages. The speed of the feed also can be slightly increased when thicker saws are used.

Care of Saws.—The saw itself needs special attention. It is an edged tool and, therefore, should be handled accordingly. Care should be exercised to keep pieces of hard material like iron, steel, or concrete, from coming in contact with the sharp

teeth. A good plan is to have a wood frame in which the saw may be carried. Often the sawing is done in a wood lot removed from the farm shop and in such cases sawing is no doubt done during spare time. The saw should, therefore, always be removed from the mandrel. It should be well greased to prevent rust. The mandrel, too, should be well greased, particularly that part which is threaded and carries the saw. The flanges, too, should be greased to prevent rust. The saw itself should always be set in a perpendicular position. Good practice is to hang it on a wooden peg in a dry place.

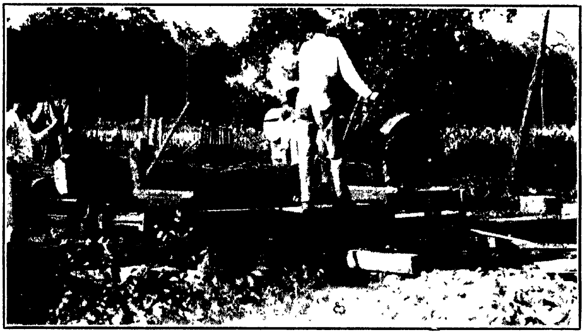


FIG. 268.—Saw mill showing dogs holding the log.

It should be well secured so that there is no danger of its falling and injuring anybody.

Capacity.—Farmers' Bulletin No. 1023 has the following to say about capacity of cross cut saws:

"The rate at which wood is cut with a good-sized outfit depends almost entirely on the speed with which the wood is brought up to the saw, and the skill of the sawyer and his helper in pushing the logs and poles forward into position without unnecessary loss of time. Under average conditions such an outfit as this should cut in the neighborhood of 20 cords into stove lengths of 12 to 16 inches in a 10-hour day, if kept working steadily. With a crew that works together well, and a saw and engine that are in first-class condition, the output can easily be made greater than this.

"The two men should be able to cut the whole year's supply of wood for the farm in two or three days, and if they can do this without neglecting other work, it may be more economical than hiring extra men. Similarly, two men, or even one, can operate the saw in cutting cordwood into stove lengths. However, if a full crew can be got together by exchanging labor with neighbors, the work can be done more quickly and easily and with less cost for fuel for the engine."

Power Required—The power required to do work at this rate is considerably below what is available with even the smallest 2-3 plow tractor which, therefore, is an assurance that plenty of power is available in tractors that may be used for such sawing work.

The following table gives approximate power and capacity figures for portable saw mills used for ripping hard wood logs into boards. Capacities in soft woods are about 25 percent greater.

CAPACITY IN BOARD FEET	POWER REQUIRED	APPROXIMATE DIA. OF LOGS	DIA. OF SAWS RECOMMENDED
3500 to 5000.............	10 to 20	30	48
4000 to 7000............	12 to 24	35	54
6000 to 10000......	20 to 40	40	60

The amount of timber that may be handled depends on the power available, the size of the saw, and number of teeth, and whether the material is hard wood or soft wood and the number of men in the crew.

CHAPTER XXVI

BALING PRESSES

Function.—To compress loose hay, straw or other loose material into a compact quantity of a fixed weight commonly termed a "bale" is the purpose of this machine. Loose hay, on an average, weights from four to five pounds per cubic foot. Baled hay, on an average, will weigh from twenty to twenty-five pounds per cubic foot. It is possible to increase this and sometimes its density is made as much as thirty-five pounds per cubic foot. This last figure, while possible, is not practical because of the extremely hard work and the stresses on the machine and because of the difficulties encountered in handling these bundles, which, in such cases, become quite heavy. A modern hay press or baler, as they are also termed, not alone presses the hay, but provides for holding this rectangular bale in shape by the aid of wire commonly termed a "Bale-tie." The machine should have liberal capacity for work, should make bales of uniform size and very compact and straight. It should also be made in a manner so that it may be opened up in a way convenient for feeding purposes.

Types, Sizes, and Rating.—Hay presses for use with tractors are of only one common type or style. They are, in general, alike and all have about the same characteristics. Feeders are available on many machines, which aid in increasing the capacity of the machine. While mechanical or automatic tying mechanisms have been tried, they are not as yet a practical device, therefore, all tying is done by hand with baling wire ties made for this purpose.

These machines are rated in a series of sizes which correspond with the rectangular cross section of the bale in inches.

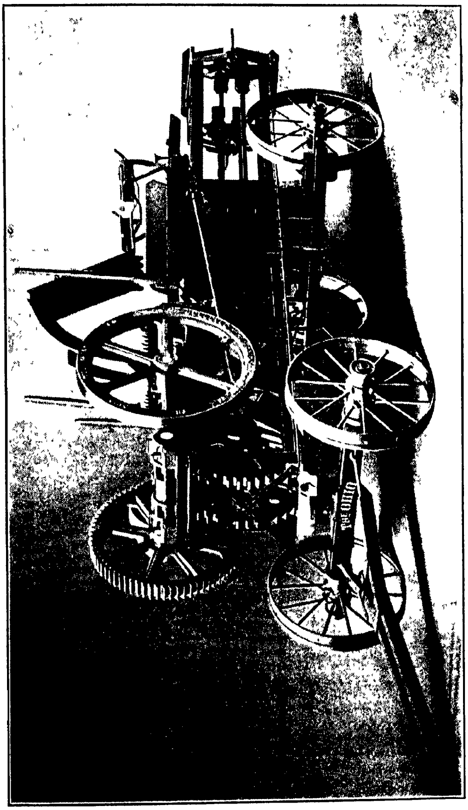


FIG. 269.—Hay baling press.

The most common sizes of bales in inches of rectangular cross section are 14 x 18, 16 x 18, 17 x 20, 17 x 22 and 18 x 22 inches. The most popular sizes, however, are 16 x 18 and 18 x 22. The length of the bale may be made so that it will weigh a given amount. Usually these bale weighs are 75 or 100 pounds each. This is about what one man can conveniently handle. The size to use is one of individual choice. No fixed rule is used for choosing any particular size and no particular size may be given as a standard.

Field Operation.—Since practically all baling is done out of doors, there is always a splendid opportunity for lining up and setting the machine with the tractor in the best manner possible. If baling is to be done in a barn, care should be used so the tractor will be out of doors. The fumes from the exhaust are poisonous, and besides this plan eliminates danger from fire.

Be sure to run the fly-wheel on the baling press in the direction indicated by the arrow which in most cases is cast right on this fly-wheel rim. On machines that have no marking, there is probably no difference in the operation whichever way the fly-wheel rotates.

In many cases the speed at which the fly-wheel should run is marked on the wheel itself. If not, it may be printed on the frame nearby. Be sure that this part is run as indicated to get the proper results from the machine. Most balers have a plunger speed of about 20 strokes a minute. This has been found to be about as fast as good work can be done. It also means that it is about what can easily be handled in tying and in feeding.

Oil all the bearings very thoroughly. Do not neglect the bearings of the pitman. These have hard service and need special attention, both at the crank pin and at the plunger. The gears, too, should be greased with axle grease. This makes for easy running and minimum friction. These gears should be given a greasing each day.

It is a good plan to try the block dropping device before

belting the machine and the tractor. Paint often causes it to stick and turning the fly-wheel by hand to test this will, in the long run, prove a good plan. Try all the blocks to be sure that all will drop into place easily and freely. There should not be any tendency in any of them to stick. The various machines all have devices that differ slightly, but all are simple and easy to understand and operate.

One of the next things to do is to set so that it will be convenient to pitch from the mow or the stack into the machine hopper or onto the feeder, if the latter is used. If setting

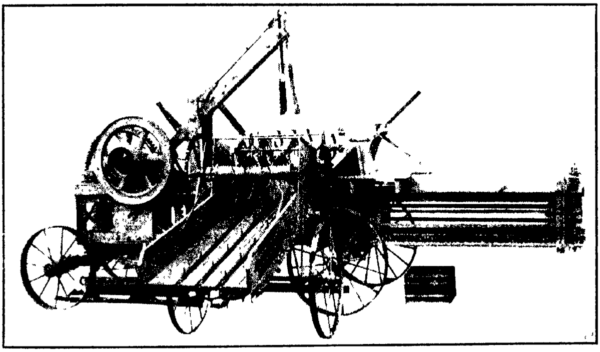


FIG. 270.—Baling press with feeder.

close to a large rick or stack and no feeder is used, a platform may be set up alongside the feed opening on which the man may stand who feeds the hay into the condenser of the baler. This platform then affords ample room and space underneath for the operator of the tying device. If alone, he must work around on both sides of the baler to be able to thread the baling wires through the block. Two men are sometimes required to do this when fast baling is done. They usually handle the tied bales together to make work easier. If no feeder is used, the loose hay or straw, or other material, is fed into the upper part of the baler feed opening.

Most modern balers have what is termed a condenser just above the opening into the baling chamber. This condenser contracts and prepares the material for entry into the chamber by the acting of the foot feed. The condenser should always be kept full so that the greatest capacity of the machine may be obtained.

When starting a machine some care should be used to get the proper pressure on the baling chamber so the bales will

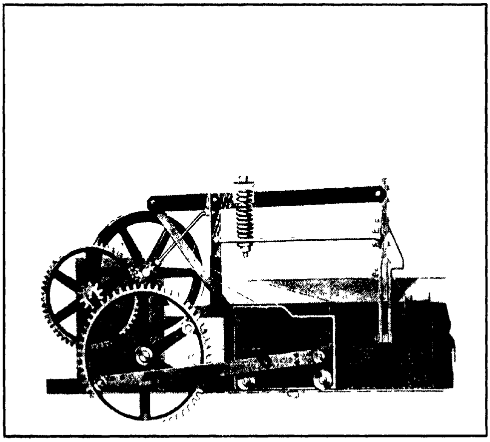


Fig. 271.—Sectional view of baling press showing foot feed, plunger and gears. Dotted lines show movement of plunger and foot feed.

become tight and compact. Screws are provided for that purpose and it is a good plan to set them up gradually. The first bundle should not be tied. One of considerable length should be made in order to fill the chamber, against which the regular bale may be made. As soon as the chamber is full and sufficient pressure is obtained, a block should be set in place and tripped into the chamber. This, then, will be the beginning of the first finished bale.

Since a bale of a fixed weight is to be made, a scale or

weighing device of some sort should be available to get this bale nearly correct as to weight. A platform scale or a portable beam scale will do this work well.

A bell signal device is provided on all balers so that an alarm will be given to let the operator know when to trip the block into the chamber. When this is set and the material being baled remains the same, no further attention need be given to this question. Checking the weight every few hours will be good practice anyhow, since it will reveal whether any change has taken place to alter the weight. If too heavy, the tension may be loosened. If too light, the tension may be increased.

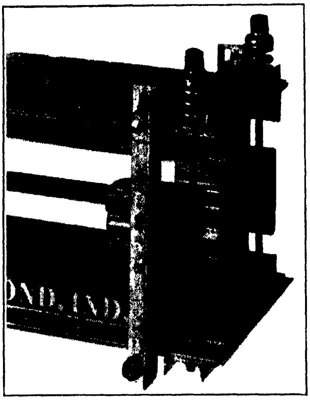


FIG. 272.—Tension device at end of baling chamber to govern compactness of bales.

The foot feed should be set to work down into the baling chamber to within about three inches of the bottom. If the man who feeds the machine feeds uniformly, whether to a regular feeder or directly into the condenser, the work of the foot feed will be materially aided. Too often very uneven bundles and bundles with ends sticking out around them appear. This is due to uneven feeding. It can easily be corrected by feeding more carefully and uniformly. A little practice will soon prove that this is not a hard task, though judgment, of course, is necessary. Care should be used so that the feeder is signalled each time a block is dropped. This will then permit getting the block in at a time when the chamber is empty. It, too, will permit having the foot feed carry in the next fork full so that bales will be square ended and of good shape. Frequently, bales that are decidedly bent will begin to appear. If a bale shows

a tendency to bend up in the center of the top part, less material should be put into the chamber near the top. If the foot feed does not travel down far enough, it should be made to do so. If a bale is bent in a sidewise direction, the tension is not properly and evenly set. A twist is often the result of improper tension. The remedy is to loosen side toward which the bale twists, or tighten the opposite side. Bales also get

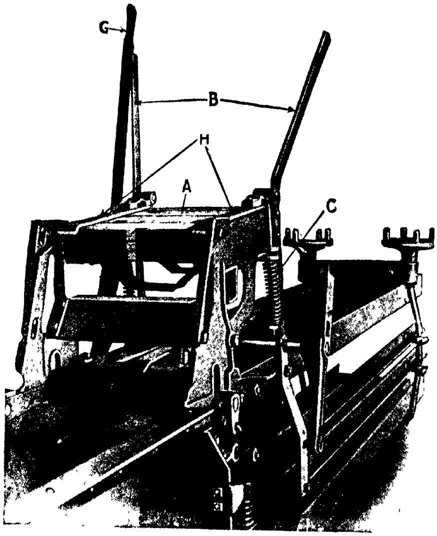


FIG. 273.—Block dropping device. A, Block; B, Lever for tripping.

crooked sidewise when machines with feeders deliver the material to one side. Feeding short material usually causes a bale to bend toward the opposite side from which it is being fed. This shows that the material should be fed farther into the chamber, more nearly in the center; if this is done, the trouble can easily be corrected.

The block dropping should be attended to by the man who is responsible for tying each bale. He will have time enough

to do this and is in the best position to handle the two jobs together. On some machines provisions are made for the man feeding the machine to trip the block dropper with his foot at the proper time. Tying should be done on the side on which the feeding is done. This enables the man who does this to keep close watch on the feeding. Since the block dropping, too, is usually watched, by the same person, he can control the

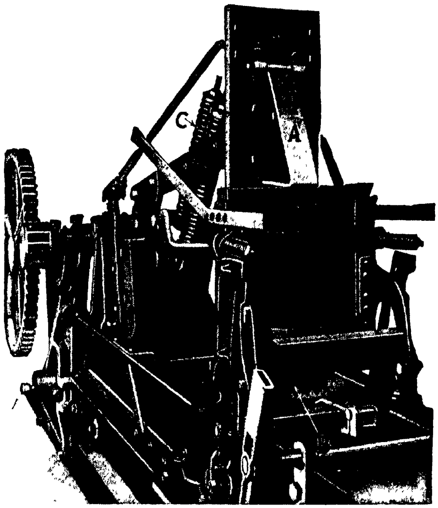


FIG. 274.—Block in position to enter baling chamber.

feeding, block dropping, tying and size and shape of bundles. Usually one man can attend to all these matters. Of course, if a large custom baling press is being used, it will require two men to look after this work. One on each side is the logical arrangement. These two men then handle the bale tying, each one looking after the work on his side only. In such cases the man on the feeding side does the signalling and attends to the block dropping.

Since these machines are very simple there is no very complicated mechanisms to get out of order. The usual care given to any farm machine is about all that is required. The bearings, if babbitt and in boxes, should be set up to keep out all play. The pitman, connecting the wrist pin to the plunger, has bushings which should be replaced if they show a tendency to pound due to wear. The blocks which are made of wood should be kept in good shape. Too often the blocks become

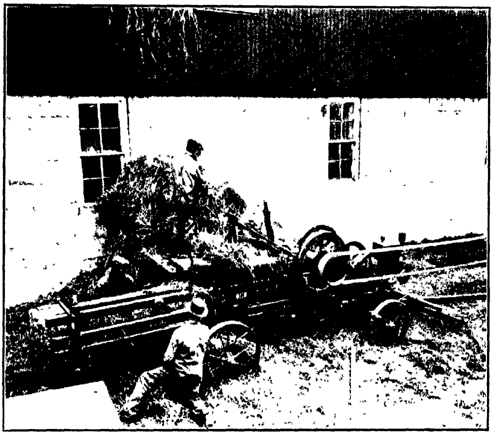


FIG. 275.—Baling from a barn mow.

warped or crooked, which hinders their working well in the dropping device. Good work cannot be done if the blocks are not doing their work well. A damaged block should be discarded and new ones purchased. It is a good plan to have several extra blocks on hand.

Capacity.—An ordinary 14 or 16 x 18 baling press will turn out from 15 to 25 tons of hay per day of ten hours. A 17 x 20 will do from 20 to 30 tons per day, a 17 x 22 from 22 to 32 tons and a 18 x 22 from 25 to 35 tons.

Hay, particularly alfalfa, is often handled directly from the window to the baling press and, therefore, the distance it is to be hauled has an influence on the capacity. While these figures are general, it may be said that under ideal conditions, considerably more may be done in a day and often as much as 15 or 20% more than the figures given.

Power Required.—The power needed is very small. Ordinarily, even the small two-plow tractor will have ample power to operate a baler successfully. In general, it may be said that rarely does it require any more than fifteen horse power to operate a baling press to capacity under good conditions. This question needs very little consideration since these machines require such a small amount. Under severe conditions and with a large custom machine, it may run to as much as 20 horse power, however.

CHAPTER XXVII

IRRIGATION PUMPS

Function.—The purpose of an irrigation pump is to provide water from wells or other sources to those farms in the arid sections that do not get sufficient rainfall to grow crops successfully. There are several ways of irrigating, and pumps are used in those places where it is impossible to let the water in by gravity through flumes or ditches from natural sources.

Types and Sizes.—There are two distinct types of irrigation pumps that may be driven by the tractor—the rotary and the reciprocating pump. The first is also termed a "centrifugal" or turbine type, the latter a "plunger" pump. Each of these may be sub-divided into horizontal and vertical styles. They may be further divided into single or muliple stage types. The "plunger" type pump may be single or double acting. The selection of one or the other of these pumps varies with the localities where they are used.

Field Operation.—The horizontal type of centrifugal pump can be successfully used where sufficient water can be obtained near the surface, and the pump can be installed close enough to the supply so that it may be belted directly from the tractor. It must be made certain that the pump is well set and anchored so that a tight belt may be used. Where the lift is very high, say from twelve to twenty feet or more, the vertical type pump should be used. In such cases the well must be of a size big enough for the pump to be located and well anchored near the bottom. Rigging or timber supporting the vertical shaft should be installed similar to the method shown to afford means of delivering the belt power from the tractor to the pump proper through a vertical shaft. A vertical

shaft of this sort calls for bearings specially designed so that they may be properly lubricated. Oil must be introduced near the top, and held there, or else the bearings will run dry, and become heated, and probably burn out and cause trouble.

Plunger pumps of either the single or double-acting type are usually belted through a jack, thus forming a reducing gear at the plunger. It is important that the rigging be well anchored to a solid foundation to get good results from the plunger pump. The amount of water to be pumped will, in a measure, govern the selection of one or the other types.

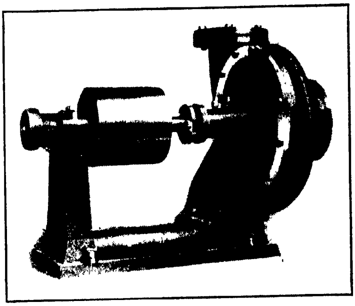


FIG. 276.—Horizontal centrifugal pump (single stage).

The operation of rotary pumps is comparatively simple. The horizontal type belted directly to the tractor with a straight or crossed belt will need little or no care, other than proper oiling of the main bearings. A medium grade of oil of good quality should be used. During colder weather lighter oil should be used. It must be remembered that the belt pull is quite heavy, and, therefore, special attention must be given the bearings at this point. The pumps should always be tight so that there is no leakage.

These facts also apply to the multiple stage type. They have the advantage, however, of handling a greater amount of water than the single stage type. There are more joints to be kept tight, and it is also well to remember that these pumps must always be primed when they are placed above the water level—which should never exceed eighteen or twenty feet and should be as much lower as practical. Theoretically, a pump at sea level should raise water thirty-two feet by suction. The altitude and the friction of the

water in the suction pipes affects this, and the efficiency of the pump as a whole. Since the principle on which these pumps work is that of maintaining vacuum, not only the pump joints but all the suction pipe joints should be kept absolutely tight. Wherever possible, care should be taken to keep the suction pipe straight, or at least as free from bends as possible.

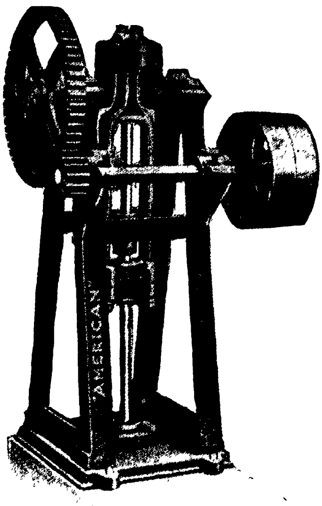


Fig. 277.—Plunger pump.

Vertical pumps are usually placed in a well which is dug and boxed, or cemented inside. The pumps are set at the bottom where an abundance of water is always available. Even artesian wells that yield from seventy-five to one hundred gallons a minute may, by pumping, frequently yield eight or ten times this amount. As already stated, vertical pumps set in these pits should be well anchored and the pit should be large enough that the operator may conveniently get to them, and attention be given them and the vertical shaft with regards to lubrication.

Where there is danger of getting fine sand or quicksand into the pump, it is important that a very fine strainer be used at the end of the suction pipe. The strainer is usually made of iron with slits in it, beveled on the inside so that particles which get through into the slits will not tend to plug up, but pass by.

The casing must always be well perforated to be sure that

sufficient water is always available and this sometimes becomes the limiting factor in the performance of the pump.

The plunger pump is usually operated from a pump jack to which the tractor is belted. In using these pump jacks it is well to see that the entire mechanism is housed. If possible, a housing may well be built over the tractor, so that it, too, may be run under cover. This also will apply to the centrifugal pump. The pump jacks or plunger pumps should be well cared for. The gears should be greased and the bearing caps kept tight. When the caps loosen as is often the case, there is a pounding, and the bearing metals are pounded out in a short time. It will also be found utterly impossible to keep the bolts tight if they have started to loosen in the threads. If, however, parts are taken care of from the first and not allowed to pound, no trouble will be experienced from this source. The jacks should be oiled very regularly and with a good grade of medium heavy oil.

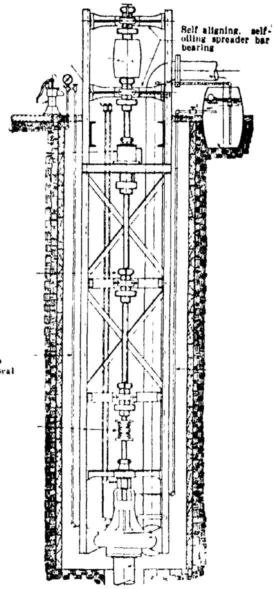


Fig. 278.—Vertical centrifugal pump.

Ordinarily it is not desirable to try to operate a pump with a suction lift over 25 feet at sea level and in general one foot less for each 1000 feet above sea level. One horse-power is the force required to raise 33,000 pounds one foot per minute; therefore, to find the horse power required for a

pump, it is necessary to determine the number of gallons desired per minute, which, multiplied by the height in feet and by $8\frac{1}{3}$ the weight of one gallon of water, will give the number of foot pounds per minute. The product divided by 33,000 will give the horse-power required. To find the approximate theoretical horse-power required for a pump, multiply gallons per minute by height in feet and divide by 4,000. Actual horse-power required for small units will be at least double the above amount. The efficiency of the motor or engine which is to operate the pump must also be carefully considered; on very small sizes this is sometimes not over 50 percent. Correct alignment and adjustment greatly affect the amount of power consumed.

Capacity and Power Required

The Capacity of a Pump Depends Upon:

I. Diameter of cylinder.
II. Length of stroke.
III. Number of strokes in a given time. (Usually one minute.)

The Power Required Depends Upon:

I. Quantity of water desired in a given time.
II. Vertical height to which water is to be raised.
III. Friction in the pipes and in the pump itself.

Centrifugal Pumps

Size of Discharge Inches	Gallons per Minute	Number of Acres Pump Will Cover 4″ Deep Running 12 Hrs. a Day for 30 Days at Average Capacity	Size Belt Recommended Inches Wide	Speed of Pump	Approx. H.P. Req. under Avr. Conditions
3.........	175–300	25–30	5–6	3500	8–12
5.........	600–800	80–120	7–8	3000	12–15
7.........	900–1600	150–200	8–10	2800	15–25
10.........	2000–3500	400–450	10–12	2500	25–40
12.........	3500–4500	500–600	12–14	2000	40–70

Since for irrigation a large amount of water is usually required during a short time, it is logical that a pump of this sort be used.

Plunger Pumps

Plunger pumps do not have such great capacities for similar sizes. The following table will serve to show what plunger pumps will do on an average:

Cylinder diameter inches	Stroke inches	Pressure in pounds	Revolutions per minute	Displacement in gallons per minute	Approximate horsepower
3	4	70–80	65–70	32	3–4
4	6	80–90	50–60	78	5–7
6	10	80–90	40–50	190–220	12–15
10	10	60	40–50	500–600	25–30

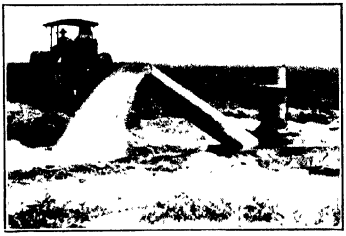


Fig. 279.—Centrifugal pump in action.

Useful Information

Stock will drink the following quantities of water per day:

Horses, 5 to 10 gallons. Hogs, 2 to 2½ gallons.
Cattle, 7 to 12 gallons. Sheep, 1 to 2 gallons.

About 1½ gallons are required to fill an ordinary lavatory; 30 gallons to fill the average bath tub; and from 7 to 10 gallons to flush the closet.

The average suburban family uses about 50 gallons per day for each person. Watering of cattle, sprinkling of lawn, etc., should be figured extra.

With 40 to 50 pounds pressure per square inch, an ordinary ¾-inch garden hose nozzle requires about 6 gallons per minute when throwing a solid stream, or about 4 gallons when spraying.

Approximately 8 gallons are required to sprinkle 100 square feet of lawn; 16 to 20 gallons will soak it thoroughly.

The above table may serve to show what a centrifugal pump will do under average conditions of low lift and with average speeds and power.

PART III

MISCELLANEOUS TOPICS

CHAPTER XXVIII

ENGINE CULTIVATORS

Function.—The purpose of this machine, which is frequently termed "motor cultivator," is to cultivate row crops. Because of the limitations of the average tractor of the conventional type a machine has been designed to handle these row or intertilled crops, principally corn. The great area of corn, together with its importance, makes it the predominating one to be handled by these machines. Cotton, too, may be successfully worked with them. They should, therefore, properly cultivate to maintain a mulch and to destroy weeds. They should be able to "hill up" or "lay-by" when necessary. This machine should be able to turn short, to get around the headlands and should be able to straddle or go between the rows without danger of injuring the plants. It should handle this work on hillsides and in ground that is very soft without danger of packing the soil or injuring the growth of the plant. The operator should be able, from his seat on the machine, to handle the power plant, as well as the tool bars, in the easiest manner possible and with the least expense of power. These bars should be easily operated laterally, and it should be convenient to set them to the proper depth. This machine should also lend itself well to the use of corn planting machinery using the greater part of the conventional two row corn planter.

Types and Sizes.—There are two sizes of machines, namely: Single and Double Row cultivators. These machines are frequently rated at about 5-10 or 6-12 horse-power. They are built in several types, the two most common being the pivot axle and rigid axle machines. In the former, the pivot axle

type, the drive wheels usually are the forward wheels, using a single or double castor wheel behind. The gangs are connected to the frame. In most cases these gangs move with the action of the pivot wheels and as the operator guides the wheels, so the gangs are moved. In other words, he is enabled to guide the machine close to the plants and follow the irregularities by swinging the wheels from side to side. This work is usually done by treadles which the operator moves with his feet as is the case in the regular pivot axle cultivator. Turning short on the headlands is accomplished by means of brakes on the dif-

FIG. 280.—Engine cultivator (pivot axle type).

ferential of each drive pinion shaft. The width of the machine may in most cases be altered to suit the width of the rows to be planted or cultivated.

In the rigid axle machine, which usually carries the steering wheel or guiding wheels in front, the gangs are nearly always moved independently. In the latter style, guiding of the shovels is usually done by regular treadles, located in a convenient position for the feet of the operator. The steering is done by the aid of a steering hand-wheel which acts on the front wheels.

Small tractors that are narrow enough to go between the rows are being used in combination with special cultivating

attachments which enable the operator to do good cultivating. Such machines usually provide means for short turning on the headlands and for setting the cultivator shovels to suit the width of the rows and to the depth required to do good work. With some tractors called general purpose machines, cultivating row crops is done by using a regular cultivator in combination with this tractor.

Attachments.—Since these machines are primarily cultivating machines, shovels, sweeps, discs and so forth of various

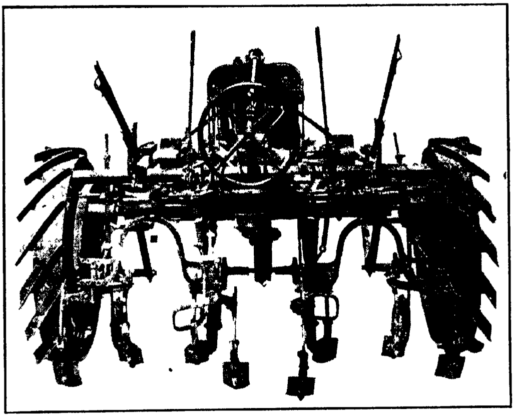


FIG. 281.—Engine cultivator showing shovel arrangement.

kinds and types may be procured to use with these machines for different purposes because corn, cotton, peas, beans and many other row crops may be cultivated. The success of this work is in a great measure dependent on the skill of the operator and his judgment in doing this cultivating with such a machine. Planters for drilling or checking corn may be procured to attach to some of these engine cultivators. Such work may be done in a very satisfactory manner, if work is properly organized and the field properly layed out. Since the machine

is primarily a tractor, there are other farm operations that may be successfully done. Any light draw-bar work such as drawing a hay rake, hay tedder, hay loader, etc., may be done. On many farms even rolling, seeding and harrowing may be done by the aid of this power unit.

A belt pulley on these machines permits using them for a variety of purposes where power requirements in general are not in excess of from 10 to 12 horse-power. Judgment in the way of using these machines for belt work must be used to get the most out of this kind of a machine. It is folly to attempt

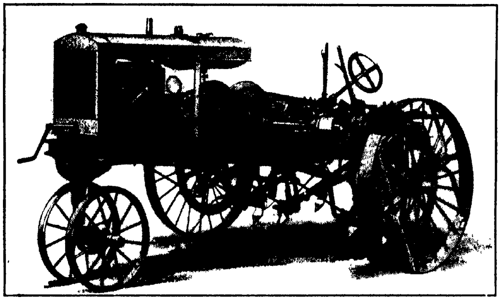


FIG. 282.—Engine cultivator with double-steering front wheel.

work with a belt, for such work should always be done by the tractor and not by an engine cultivator.

Field Operation.—Since these machines all contain a power plant, together with a transmission and driving mechanism, they require a good deal of attention so far as these parts alone are concerned. Whatever care is given the ordinary tractor will apply equally well here, and instruction books which accompany these machines, covering these mechanisms, should receive the careful consideration of the operator. The proper assembly, if one of these machines should be received "knocked down," is of vital importance. Too often either the dealer or the farmer, if the machine is sent direct, takes too much for

granted and fails to read the instruction books which give directions for setting these machines up properly. Unless these are properly set up, they cannot be expected to do their work well.

One of the first essentials to consider, in using one of these machines to cultivate row crops, is to plan the farm work accordingly. Headland of sufficient size to enable the operator to turn is of vital importance. In practically all cases these

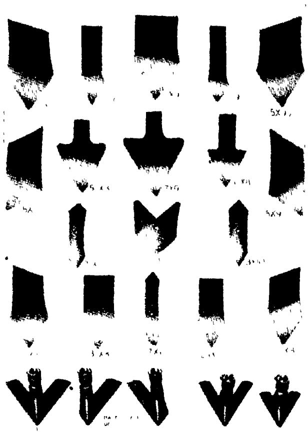


FIG. 283.—Cultivator sweeps and shovels of various kinds.

machines require no more room than when animal power is used. Crops should not be planted so close to the ends that in coming around the headlands the plants will be run over or otherwise damaged and this, therefore, should be guarded against. It should also be the aim of the farmer, in planting his crop, to get the rows as long as possible to avoid turning at the headlands oftener than is necessary. If two rows are planted, the same two should be "plowed," as corn cultivating is very commonly termed. It may be convenient in turning at

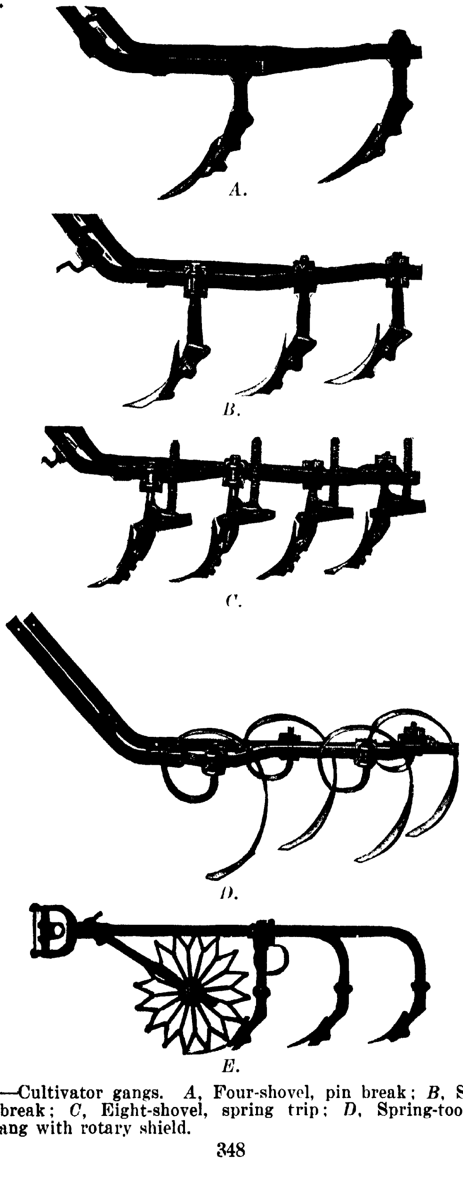


Fig. 284.—Cultivator gangs. *A*, Four-shovel, pin break; *B*, Six-shovel, pin break; *C*, Eight-shovel, spring trip; *D*, Spring-tooth gang; *E*, Gang with rotary shield.

the ends to skip a set of rows or two at each end of the field so that turning short will not be necessary. In such cases it should be comparatively simple to cover the field without danger of injuring the plants at the end of the rows. While this is not necessary it can be done, but, of course, it is possible and also practical to turn around short at the end and follow down all adjoining rows. This latter plan permits doing the cultivating in the shortest period of time since the time spent on the headlands is at a minimum.

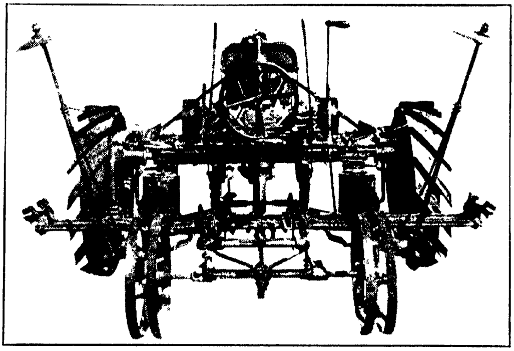


FIG. 285.—Engine cultivator with planter attachment.

The number of shovels used on the gangs, together with the type, is a question that is determined by the crop being cultivated and the soil characteristics involved. It is also a good plan to use a narrower shovel forward, because in traveling fast, as with these machines, the ground is thrown over more. It is of the utmost importance in going over the field for the first time to produce a mulch and at the same time to dig out the weeds, to be very careful of these small delicate plants which are dislodged very easily. In ground which has dried out rapidly after a rain that is being worked for a mulch, it is particularly important to get onto this soil and work as soon as possible without danger of getting stuck. In low lands this

is more important than on high lands and sandy soil. It must be understood that the yield is decidedly influenced by the elimination of weeds which sap the nourishment from the soil which should go to the plant. Early, frequent, and thorough cultivation is the secret of success. As first cultivation is usually done in the early season, it may be necessary to use extension rims on the wheels to prevent packing and to give sufficient traction for the cultivator.

Shovels.—The parts of the machine which work in the ground are commonly termed "shovels." An endless variety of types and kinds to suit various crops and soils are available. These are usually secured to a vertical member, the "shank" or "standard." These, in turn, are fastened to longitudinal beams. The whole member is commonly termed a "gang."

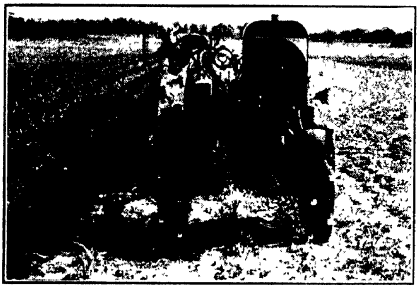


FIG. 286.—General purpose tractor, with two-row cultivator attachment.

The illustration (Fig, 283) shows shovels of various kinds, types and sizes. Some of these are even termed "sweeps." On some gang combinations, discs are even furnished in combination with shovels. For surface cultivation, these shovels are termed "blades." On nearly all gangs, various combinations can be made to use either two, three, four, or more, of these shovels. Most of these shovels are provided with a safety device, so that if one of them strikes a hidden obstruction such as a stone, or stump, which is underneath the ground, instead of bending the standard or straining the machine, a wood break pin is merely sheared off which allows the shovel to trip back and become inoperative. On other

machines these shovels are provided with what is termed a "spring trip." In such cases it is unnecessary, as in the previous one, where a pin had to be renewed, to do anything other than just drop this shovel forward against where it is held by the compression of a coil spring. Frequently, in soft ground, by slowing up a little, the shovel will trip back in place by itself.

In going over the field the first time or two it is important to use plant guards which are usually made of sheet steel and so placed that they run on either side of the row being cultivated. These sheet steel guards may be a rotary type instead of stationary where localities prove that this is satisfactory. the purpose of these guards is to keep the inside shovel from turning the soil over on the row injuring the young plants. The adjustment of this part. therefore, becomes a question of setting it so the plant will not be injured, and this is done by setting the guard and front shovels to suit the conditions and the soil. These shovels should also be set so they have the necessary penetration or "suck," as it is commonly called. This means that they must be set so that they pull into the ground and have a tendency to go deeper. This action, of course, is counteracted by the hanging of the gang as a whole.

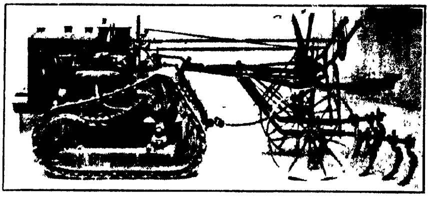


FIG. 287.—Narrow tractor to pass between rows with two-row cultivator attached.

These shovels are generally made of soft center steel, similar to that which is used in plows. They are tempered and polished so that the soil particles will slide over them with enough pressure so there is no tendency for it to stick. In such soils where there is a tendency of this sort, these shovels

must be set with more suction to hold them into the ground which will make the pressure considerably greater in sliding over them. This tends to scour them, which keeps them clean.

Another item in the adjustment of these gangs is to be sure that they are counter-balanced properly by the spring provided for this purpose. This will assist the operator in lifting the gangs at the ends of the rows with the least amount of trouble. In other words, adjustments are provided that permit hanging gangs so that they balance very nicely. This balance is effected by using different shovel combinations and the operator should, therefore, use some care to get this balance as nearly perfect as possible for the shovel and gang combination which is being used. The adjustment of these gangs with reference to width for two row cultivating is also important. If the crop is planted in rows 42 inches, 44 inches or whatever it may be, the gangs should be adjusted to correspond. Very often this is neglected and the result is that one set of gangs will do perfect work whereas the other one may travel so far away on one side that poor work is the result. This, too, should be watched to get the best results from machines of this sort.

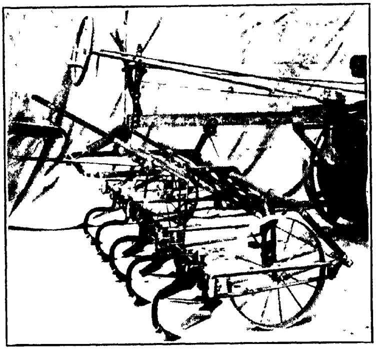


FIG. 288.—Tool-bar, with beet-cultivating attachment.

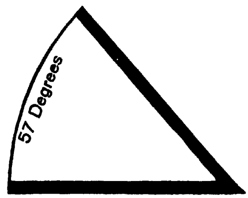


FIG. 289.—Correct angle of cultivating shovels.

All shovels should be thoroughly cleaned and well greased between cultivations and again at the end of the season. At this time it is a good plan to remove them entirely so they may be sharpened before the next season's work if necessary.

Capacity.—So many factors enter into the amount of work that may be done by one of these machines that it is difficult to give any exact figure on the amount of land covered in a day. The speed at which they travel has the greatest influence on the capacity of work. The distance between the rows also has an influence on the acreage that can be covered in a given time. The thoroughness with which this work is done is of utmost importance and should always get the first consideration of the operator. While the fact that one of these machines is able to travel, particularly after the first or second cultivation, considerably faster than horses would work, means that more work can be done. The fact that it will never be necessary to rest these machines, and that the work may be carried on through the hottest days, even by a double shift by daylight and night, if lights are used, means that considerable acreage can be covered. With these conditions existing the limiting factor becomes the operator, and since most of these machines have provisions considering his comfort, it is apparent that the acreage covered is greatly influenced by the factors mentioned above.

FIG. 290.—Cultivator shovels set too deep will cut corn roots and damage the plants.

The capacity of an engine cultivator is ordinarily from 16 to 18 acres of checked corn with a double row type in a day of ten hours. Drilled corn can be cultivated on an average of

from 18 to 22 acres a day. Therefore, while the acreage covered per day may be as given above on an average, many farmers are able to do from 20 to 25 percent more. In other cases a novice may be able to do only 10 or 12 acres a day. Experience and practice in this work, as in any other kind, has an influence on the amount of work that may be done in an average day. Experienced operators can do as much as 24 or 30 acres a day. On hill sides more care should be used and this reduces the amount of work somewhat. After all, it is the thoroughness of the job more than quantity done in a day that reflects in the yield of the crop. It is, therefore, safe to say that 20 acres a day may be done on an average of all cultivators under good average conditions where the machine is kept going an entire day of ten hours.

Fig. 291.—Shovels and sweeps properly set will do effective work without damage to plants.

Planting Corn with one of the engine cultivators and an attached corn planter, whether drilling or checking, may be done in exactly the same way as would be done with horses. Rows, however, can be planted straighter and also a little faster, particularly when drilling. The planter should be attached according to instructions accompanying the machine. The choice of furrow openers is one dependent on locality. The care required of this machine for use with mechanical power should be the same as it should get when used with other power means. The time formerly required to rest animals, which always

afforded a splendid opportunity to oil up the machine, is now eliminated; and consequently special attention must be paid

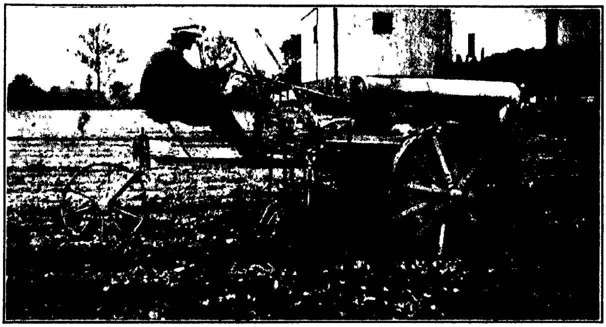


FIG. 292.—Cultivating young corn.

to the oiling of all moving parts; the wheels, the drive shaft, the clutch, cams, gears, sprockets and even the feed valves

FIG. 293.—Cultivator attachment with remote control for early cultivating.

need some attention. Special attachments for planting peas, beans, cotton, peanuts and other seeds or even fertilizer attachments should also always be well lubricated to be sure

that they are working properly. When discs are used either alone or in combination with the regular shoe furrow opener these should be greased often. The discs and furrow opener shoes should always be greased when the season's work is finished to keep them in good shape and polished for work the next season.

The acreage planted to corn per day will, if checking, be from 15 to 20; and if drilling is done, from 20 to 25 acres. This may be put in during a ten-hour day under favorable conditions. This takes into account fields of good average size and good level land. On hilly land or under conditions where the land is wet these figures will need considerable reducing.

CHAPTER XXIX

GARDEN TRACTORS

Garden tractors are machines which are self-propelled and used primarily for truck-garden work. They are principally operated by handles and the operator walks or rides on a sulky attachment behind the machine, from which position he is able to guide and control it.

Function.—The purpose of this machine, as the name indicates, is to handle garden work, to plow but primarily to cultivate. Unlike the regular engine cultivator, which is used primarily for cultivating, the garden tractor may also be used for planting, harrowing, etc. The size, however, is the first factor that determines the difference between this machine and the cultivator mentioned in the previous chapter. The garden tractor, while engine driven, is guided and operated by the aid of handles and levers that usually extend toward the rear and by the aid of which the steering and lateral movement of the cultivating members are governed.

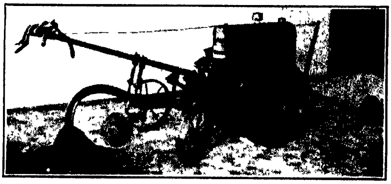


FIG. 294.—Garden tractor with plowing attachment.

Types and Sizes.—The general difference between garden tractors is hardly apparent to the average person. They are practically all two-wheel machines. They vary in weight from the smallest, weighing from 150 to 180 pounds, to the larger sizes, weighing from 750 to 1000 pounds. Some of the smaller

ones have only one drive-wheel, they are usually also single cylinder machines, and on these it is always necessary for the operator to walk.

On the larger and heavier machines, such as those rated as 2-3 horse-power, or even 4-6 horse-power, the operator may ride on a sulky attachment and control the implements from this position.

In some cases the wheels are adjustable, independently of each other with reference to depth and width. In others, they are stationary and on a fixed axle. On some machines they may also be raised or lowered for work on side hills or in a furrow. These machines have engines of different sizes and numbers of cylinders. The draw-bar and lever arrangements also vary. The general characteristics, however, are very nearly identical with each other on all the various makes. Controls, hitches for tools and handles, however, differ on the various types. All the machines will plow a furrow varying from 4 inches to 8 inches in width, the acreage plowed varying from 1½ to 1¾ acres per day, and the amount of cultivating depending on the width of the cultivator setting.

FIG. 295.—Cultivator with riding attachment.

Disc cultivators, swathing harrows, scratch harrows, rollers, and also levelers and planters may readily be attached to these larger machines for preparing the ground for planting. The manufacturers usually furnish all the necessary hitches for satisfactory attachment of tools and implements. The 3-, 4-

and 6-row garden seeder is an important machine for growers of vegetables for market. It is readily attached or detached without making changes on the garden tractor. A late development for the larger size is a riding cultivator which eliminates the walking and makes operation more pleasant and work more uniform. The turning at the end of the row and the handling of the cultivator teeth are questions of practice and the earnestness with which the operator tackles this job. Riding cultivator attachments are capable of handling a greater variety of tools, shovels and steels, etc., than the walking machines, since tools are shifted from side to side by means of the feet and lifted or regulated in depth by levers. The cultivators are attached to the tractors without alterations or interference with the various controls on the handle bars.

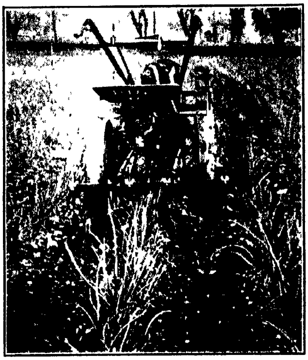


FIG. 296.—Hoeing onions.

Field Operation.—Since garden tractors, like those machines mentioned in the previous chapter, have engines and transmissions, it follows that these parts should get the care that any small engine would necessarily require.

The plow is provided with the necessary hitching irons so that it may be hitched to the machine with the least amount of trouble and perform at its best under average conditions. Small plows, usually six or eight inches, are commonly used. Plowing with such a small plow is slow work and most generally the soil is therefore prepared by using a regular tractor and larger plows for rapid work.

It is very difficult to hitch to these machines without a thorough understanding of the requirements of the implement that is being drawn, and it would be almost useless for the

average farmer to try to make these hitches himself. The different machines require different methods of hitching the drawn implements and they should all be purchased from the manufacturer of the power machine itself. To try to hitch any of the present hand-operated or horse-drawn implements is folly. Considerable time and much effort has been put into the design of special equipment to go with the various machines and it should, therefore, always be used. Even then, there is every chance to make mistakes in getting these machines coupled-up with the power plant itself. Much freedom should be allowed and the thing of greatest importance is that it should be easy for the operator who walks behind the machines to operate them. Unless the machines work in harmony with the power plant, it is needless to use them.

The description given under the heading of the "Field Operation" of the various machines such as plows, planters and cultivators of various type and kinds, rollers and harrows, will apply in a general way to similar attachments, although smaller, on these garden tractors. Since the attachments are considerably smaller, they will require individual aid and care.

Sand is one of the worst enemies of these machines, both as to the mechanical construction and the traction. Hillsides or slight grades present another difficult problem to be overcome. The side slip is often quite an item, especially with an overload, and plowing is difficult, as there is little land to hold the plow up to work. A small two-way plow is desirable for hillside work. Sandy grades that are very slight will also affect the draw-par pull of the machine and require that the depth of the plow or cultivator teeth be changed.

The machine has a fixed horse-power beyond which it cannot go, and it is important not to overload it. A little overload, or more likely a soft spot, and the tractor will dig in in a moment. Care should be exercised to pull the clutch out in time to prevent digging since the lugs or angle iron cleats on the wheels dig into the soil so rapidly that the tractor is

[uickly buried with crank case resting on the ground. A ›lank, or a 2 x 4 inch timber, placed across the tractor in ront of wheels is the quickest and best device for extricating he machine under such circumstances.

Where the machine is used on hilly ground or to hill up row rops, care should be exercised to keep it running as nearly evel as possible. Upsetting the nachine would do very little damıge to it or its attachments, but t must be remembered that the [uestion is not merely one of lifting the machine up and starting t, and immediately going on with he work. To set a large machine ıp after it has tipped over is the ob of more than one man, and o upset it in a field means that nuch of the crop will be injured ›esides. In fact, if the machine s tipped over while cultivating ny row crops that are hilled up, good deal of the crop is bound o be injured. It must be remem- ered that tipping would be due o the fact that it did get on a illside or drop in a hole, and ıerely setting it up in exactly the same place where it pped would not be satisfactory. It should first of all e skidded or moved to a place where it may be satisfactorily ›t up on a relatively level footing or it will immediately p again.

FIG. 297.—Disc attachment.

Special care should be used on hills. This caution applies articularly to those machines that have a rigid axle, which ıakes it impossible to set one wheel up or down to suit such ɔnditions. It must also be remembered that even though the 'heels may be adjusted vertically, it will be impossible to go

back and forth on a side hill without losing a great deal of time adjusting wheels.

When working in onions, beets, carrots, or any truck garden crops which are planted close, special care should be used to avoid running on the growing crops with the wheels of the machine. It is equally important that the shovels do not dig into the rows and destroy large quantities of crop.

Where more than one row at a time is to be cultivated, it is a good plan always to plant as many rows at a time as are later to be cultivated. This permits a fixed adjustment of

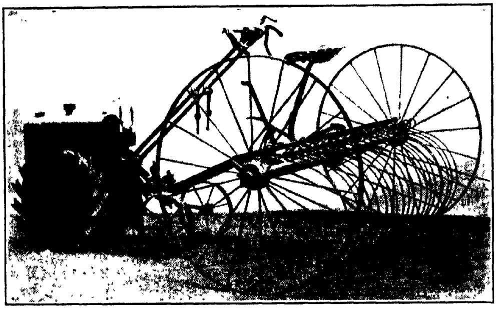


FIG. 298.—Hay-raking attachment.

cultivating gangs to the spacing of the planting. Then, too, slight irregularities in the travel can more easily be followed. If rows are slightly crooked, the same number handled at each time can always be followed without injuring the plants. One of the things that should be most closely guarded against is traveling too fast. Satisfactory work cannot be done in cultivating row crops, such as carrots, onions, etc., if the rate of travel is more than about one or one and a half miles an hour. Of course, a man can walk faster, but he cannot do justice to his work if he does. It is better to go slow and cover the field in less time during the growing period and do the work better. Plowing, discing, and harrowing, and such work as goes

with seed bed preparation, may be done faster. The limit is the rate that a man on foot can follow without unnecessarily tiring him out. If provisions are made for riding on one of the attachments or on an auxiliary attachment, then this factor of rapid travel will be unimportant. The work of running the machine should be easy on the operator. The aim should be to make the work with a garden tractor more efficient. Its various attachments for different field work should, if properly attached and operated, make it possible to do more

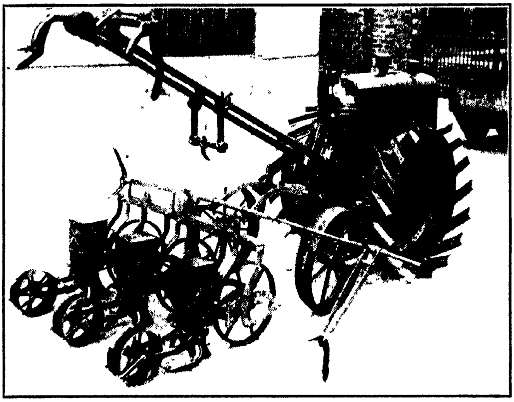


FIG. 299.—Three-row planting attachment.

work per day, and do it better and with less effort on the part of the operator, than in any other manner.

Capacity.—This is a question of machine and man power used to good advantage and with the best judgment of the man operator exercised to get capacity work. While one operator will, by the sense of his keen judgment, be able to go two miles an hour, another will be able to go only half as fast and even then do inferior work.

Plowing with a six-inch plow at from 2¼ to 2½ miles an hour will enable a good operator to do about 1¼ acres a day;

with an eight-inch plow, about 1¾ acres a day; and with a ten-inch plow, about 2¼ acres a day.

Harrowing with a four-foot disc will enable a good operator to do about 8 acres a day. With a five-foot disc he will do about 10 acres a day. A peg-tooth machine of the same width will do about the same amount of work. Such harrowing is based on a 2½-mile an hour rate of travel.

Planting onions with a machine using a 4-row seeder with rows twelve inches apart will enable the operator to do about 9 or 10 acres a day. Carrots planted in 24-inch rows with a seeder can be put in at the rate of from 4½ to 5 acres per day. Beets planted this same way and in rows the same distance apart may be planted at the same rate. This is based on a two-mile an hour rate of travel.

Cultivating at a speed of about two miles an hour will enable a good operator to handle successfully about 9½ acres of onions in twelve-inch rows and four rows at a time. Carrots, 24-inch rows and two rows at a time, can be cultivated at a rate of about 4¾ acres per day. Cabbage and beets planted in rows like carrots can be cultivated at the same rate. Carrots and beets planted 22 to 24 inches apart and cultivated four rows at a time can be handled at the rate of about 20 acres a day. All this is, of course, a question of good judgment and thorough understanding of the machine and its attachments. Some operators can do slightly more and a great many more do very much less in a day of ten hours.

CHAPTER XXX

BELTS AND BELTING

Materials.—The transmission of power from one shaft to another on pulleys is usually by means of belting. Pulley belting is made of different materials and various grades, and of a thickness and width to suit the conditions under which it must work. On farm machinery leather, rubber, stitched canvas, woven canvas and other types of belting may be found. Many carry trade names and cannot be identified or classed by these names as to material of which they are made. Rubber belting is always fabric belting impregnated with rubber.

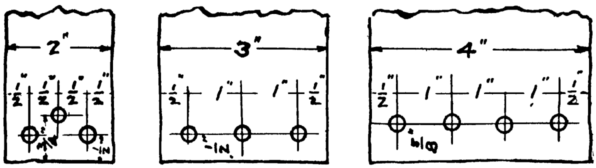


FIG. 300.—Proper spacing of holes in leather or rubber belting.

Most belts are made up in layers called "plies." A belt, therefore, may be single ply, two ply, three ply, etc. Belts are also made in various widths. Some are made endless.

Main Drive Belts.—The belt used for transmitting the power from the tractor to the belt-driven machine is usually termed the "Main Drive Belt." The main drive belt is usually of either stitched canvas or a rubber-canvas material. Usually these belts are endless and of lengths varying from 50 to 160 feet, depending on the size machine and type of tractor used to drive the same. Since the distance between the tractor and the machine is not at all fixed, it follows that end-

less belts can most easily be used here. An endless belt is made in this manner at the factory where these belts are manufactured. They have the advantage of running smooth and requiring little attention and care and no lacing. The selection of a main drive belt depends mostly on the size of machine with which it is to be used. For a tractor of 20 horse power to drive a small wood saw would ordinarily require a belt of about four inches wide. One 16 or 20 feet long would be found satisfactory for such work. However, since the power farmer usually has other belt machines to drive it is well to select one which will transmit the maximum amount of power that the tractor can deliver. In fact, a little bigger belt will be even more satisfactory. This would then serve as a drive belt for any purpose for which it is found convenient to use the tractor. A tractor rated as a 20 horse undoubtedly has some extra reserve power or its rating would require a six-inch belt of four ply material. A main drive belt of this size, 75 or 100 feet long, would prove ample to do service in transmitting the tractor's power to belt-driven machines within its range for many years, if properly belted and cared for.

MAIN DRIVE BELTS MAY BE HAD IN THE FOLLOWING SIZES AND CAPACITIES *

BELT WIDTH INCHES	PLY	BELT LENGTH IN FEET	APPROX. HORSE-POWER
5	4	75	18
6	4	50-75-100	22
7	4	100 125	26
8	4	125 150	30
8	5	125 150	72
9	5	160	42

* This list is being considered as a standard for adoption by various engineering societies and by the manufacturers.

Lacing Belts.—In some localities the term "sewing" is commonly used instead of "lacing." This is a task that any operator of farm equipment should master. To be able to lace or sew a belt properly is a qualification of which one may

justly be proud. A good lacing is one that approaches most nearly the original size and the original strength of the belt. It should be as strong as possible and not at all bulgy. Too often a mistake is made in thinking that heavy bulgy lace is a strong one. This is not the case. In going around the pulley it will jump and, therefore, wears not alone the lacing, but the

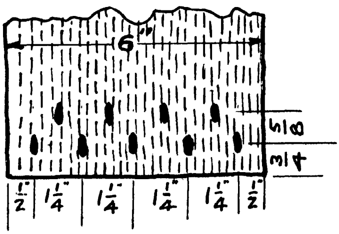
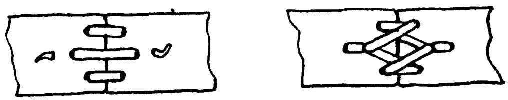


FIG. 301.—Proper spacing of holes in canvas stitched belting.

rest of the belt. Materials for lacing may be either of rawhide lace leather or metal fasteners which can be put on in a shorter period of time, and sometimes serve just as well.

The illustration (Fig. 300) shows the location of holes in leather or rubber belting that should be punched to take raw-



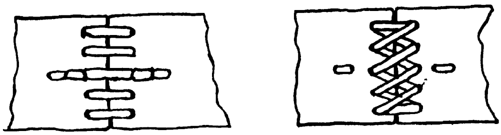
Pulley side. Outside.

FIG. 302.—A simple lace for a two- or three-inch belt.

hide lacing. It is better to use two rows of holes, that is, placing those in the rear row midway between those in the front row when possible. It is also well to remember that the ends of the belt should always be cut exactly square and this can best be done by the use of a small tri-square.

Canvas stitched belts can best be laced by using a hinged lace similar to the example shown in Fig. 304. It takes a

little longer to make this lace, but the time occupied will more than pay for itself in the service that may be obtained from a belt laced in this manner. The selection of the raw hide is of some importance. It is best to purchase a good hide and cut the laces in various widths to suit the belt to be laced. The metal fasteners illustrated are of two types. In Fig. 305, it may be seen that the fasteners hold both ends of the belt together. In replacing or renewing this type, it is necessary to cut the belt on each end back of the fastener, and it must be shortened at least as much as the space which is occupied by the fastener. In the other type, Fig. 306, it will be noticed that the metal fastener is secured to each end of the belt. The small hooks at the end afford an interlocking means through



Pulley side. Outside.

FIG. 303.—Single-row lace for a three- or four-inch belt.

which a metal or raw hide pin is put making lacing complete and holding the two ends of the belt together. In such cases when it is necessary to relace, ONLY one end of the belt need be cut and a new metal fastener put on this side. It is well to remember in putting on laces of any kind, that where belts must travel over idlers and bend in a reverse direction, particularly when pulleys are small, the lacing should be alike on both sides. If this is not done, they will wear rapidly and need replacing more frequently.

Care of Belts.—For custom machines, it is a good plan to have an extra set of belts for each machine. The main drive belt is not to be included. In such cases, repairs may be made on one set of belts while the other is being used. This will save time and prove economical. Leather belts are best cared

for by keeping them dry, that is, avoiding moisture. At the end of the season's work and, in fact, even during the year, it is well to grease them occasionally with neatsfoot oil. If this is not obtainable, an animal oil should be used on leather belts. This will keep them pliable and mellow, which is necessary if maximum efficiency from them is desired.

Canvas stitched belts can be cleaned with soap and water and painted with a good grade of linseed oil paint. This paint

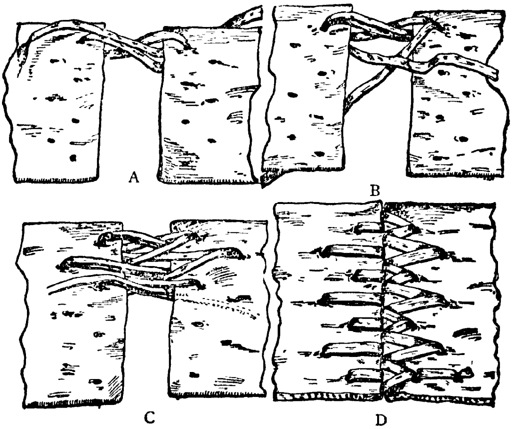


FIG. 304.—Hinge lace for a five-, six-, or seven-inch belt passing over an idler or tightener. (A good lace for main drive belt if needed.)

should be applied very thin. It is important in using canvas belts to see that the edges do not rub, for if they are worn, the belt will deteriorate rapidly since the plies are made up by folding one layer on the other and the edges are where these layers are turned. These belts also should be kept dry.

Rubber belting of various kinds is not so susceptible to moisture as is leather. However, these belts should be cleaned frequently. Dressings of various kinds on rubber belting are apt to be detrimental. These belts should be carefully watched

to see that they do not slip and get hot. In other words, that they are not so loose that there is slippage between the belt and the pulley which will cause friction and rapidly wear off the rubber and decrease their efficiency. In rainy or wet weather it is well, in any case, to stop work since no belting will transmit its power satisfactorily under such circumstances. This applies particularly to machines that may use two or three of these different belts, and unless they all work equally well, it is time to stop the machine until such a condition does exist

FIG. 305.—Metal belt fastener securing both ends of belt.

that they may all perform alike. Anyhow very little farm work with machines of any sort can be done well in rainy weather. Belts should never be run tighter than is absolutely necessary to transmit the power required. Tighteners frequently afford an opportunity to get extra tension on the belt and care should be exercised to see that they are never set any tighter than is absolutely necessary. Many tighteners are also used as idlers to get "wrap" on pulleys of small diameter. All belts should always run in the center of the pulley face. The pulleys are usually an eighth or a quarter of an inch wider than the belt on each side. The belts should run in the center

so that their entire width may always be in contact with the pulley face.

Slippage.—Very often, when the belt slips, the operator will be tempted to use resin to prevent this slipping. This is very detrimental to the life of any belt, particularly leather, and while it may prevent slipping for a short period of time, it will not, in the long run, prove helpful in solving the slipping problem. When a belt does slip, it is due to the fact that it is either too loose, or more power is to be transmitted than the belt is capable of handling, or else it is due to moisture, dirt, or other foreign substances coming between the face of the pulley and the belt itself. The remedy is to remove the cause of the slipping.

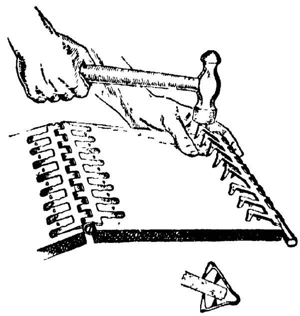


Fig. 306.—Metal fastener with steel or rawhide hinge pin.

Good belt dressings are on the market that may be used for various belt materials. Those, however, given above will serve very well. It is well to remember that a slipping belt causes heat and rapidly deteriorates the materials of which the belts are made and often the pulley covering, particularly if this material is leather or rubber. If for some reason or other a machine should become plugged suddenly, and a leather belt start to slip so badly that heat is generated and it starts to smoke, it is desirable that this belt be removed immediately if possible and if a proper dressing is not available, it should be saturated with lubricating oil instantly. Neatsfoot, tallow, or lard oil are preferable, but of not available, use what is handy. Unless this is done immediately the leather will be so completely heated that it will char and crack. It will be hard and stiff and no amount of treatment later

will do any good. The remedy then is to cut out this piece and replace with a new piece of leather belt. If sufficient length is used to get the proper tension and pulleys are of the proper size to get sufficient wrap or contact, satisfactory results will be obtained without any danger of trouble from slippage.

CHAPTER XXXI

PULLEYS AND PULLEY COVERINGS

Function.—*The purpose* of a pulley covering is to increase the friction between the drive belt and the face of the pulley. Frequently a pulley is manufactured with such material built right into it and as a part of the pulley as a whole, and in this case, therefore, it is not merely a covering, but a part itself. Many pulleys on belt-driven farm machines, particularly the main drive pulleys, are covered with some material, when not made-up as just described, affording greater friction between the drive belt and the pulley so that power may be transmitted at a minimum loss and without slippage. These pulleys in most cases are cast iron, and the cast surface is not desirable for a friction surface, when such small sizes are used. They are, therefore, covered with some material, or made and built up with some material, to supply this friction grip. Leather is the most common material used for covering pulleys. In some cases a canvas-stitched material impregnated with rubber gum is also used. Some are made with a wood covering or a wooden surface and are built up in sections, and some with a fiber or composition on the face for a covering. In either case, the purpose of all is the same.

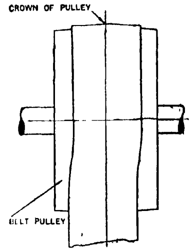


FIG. 307.—Belt running on crown of pulley.

Covering Pulleys.—Covering pulleys with leather or a similar belt material may be accomplished in two distinct ways. Since these pulleys are usually made of cast iron, dif-

ferent devices have been worked out as a means of holding the belting material to the face of the pulley. In one case, the belting material is riveted directly to the face of the pulley by means of rivets passing through small holes drilled in it. In the other case, the pulley is cast with groves of a dove-tail shape, into which hard wood wedges are driven. The leather or other covering material is secured with clout nails to these wood wedges, which are securely held. Again, although very rarely, the covered material is glued to the face of the pulley. This has not been found as satisfactory as the other two methods for farm machinery which must work out of doors. This covering material must always be kept in first-class condition to be sure that it does the work for which it is intended.

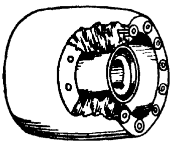


FIG. 308. — Main drive pulley of fiber.

When it is necessary to re-cover a pulley, much care should be used to see that the material is stretched very tightly before final nailing or riveting to the pulley itself. One of the best procedures is first to cut the piece of belting material the width of the pulley, if leather is to be used. If canvas is to be used, it should be purchased the exact width of the pulley. This does not mean one-eighth or one-quarter inch narrow but the exact width of the face of the pulley. The material should then be cut square and nailed or riveted across one end. A heavy weight of some two hundred pounds should be applied to the other end of the belt and the pulley slowly turned as the material is secured to its face. A loop at the end and a 2 x 4 used as a lever upon which one may stand will give the tension desired. On most pulleys the covering can be put on when the pulley is in its proper place on the machine itself. It becomes a very difficult matter to do when one is off of the machine unless a special device is available. In the factory where these machines are made, a special machine is used for the purpose. It should be remembered that the tighter the covering is stretched, within reason, the better

will be the covering. On the main drive pulley of a thresher, for instance, a load may be put on the belt by running the front truck wheel of the machine on the lower end of this covering material to grip it. If the covering material is long enough, both front and rear trucks may be run on it. After blocking the cylinder and securing one end of the pulley, therefore, and moving the machine, slack may be obtained to continue around the pulley face. The tension or load may be procured by using a bar in the cylinder to turn it and thereby get a good tight covering. This method can be followed, and it will enable one man to do the job in a very thorough manner. On pulleys that are in line with each other it is possible to get a wrap of six or eight times on one nearby and by blocking the shaft to keep it from rotating, ease it off to release slack, and cover the adjoining pulley very satisfactory by this method. Before the belting is finally cut off, it should be nailed and marked at each side. After being cut, it may then be hammered down into place and further secured so that there is no danger of its coming off in operation.

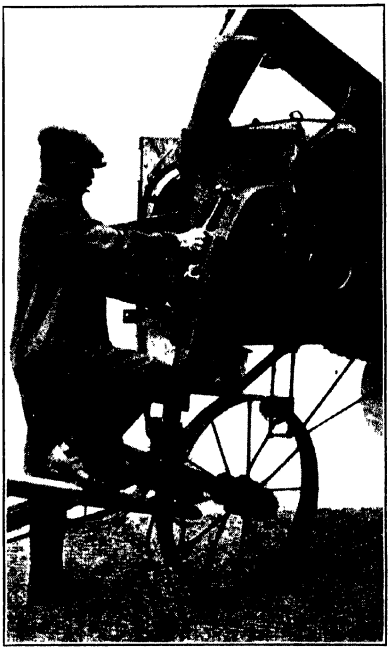


Fig. 309.—Covering a pulley.

Where pulleys that contain the wood dove-tail slats are covered, clout nails should be used that are of sufficient length to be clinched. Where the covering material is held by rivets, the rivets should be of soft copper with flat heads, and judgment must be used to see that the rivets are not pounded over and riveted so hard that there is danger of breaking the face of the pulley, which is very thin, particularly at the edges. It is only necessary to bend the rivets over to hold them properly. The success of covering will be in proportion to the neatness and thoroughness with which this job is done. The work cannot be done in an unworkmanlike manner and be satisfactory. The covering must be smooth and even. If the belting material will not stretch enough to come down on the edges, it may be that more tension put on the material by drawing it tight will bring it down on both sides. Since leather affords one of the best materials for this purpose, it should be used whenever it is possible and logical to do so. Pulleys built up of wood, fiber, or composition materials rarely need covering. If they do need it, the materials should be purchased from the manufacturer and put on as a unit. If metal fasteners are used for belt lacings, they should be well hammered down so that they will not injure the pulley coverings. What has been said in the chapter on "Belts and Belt Lacings," with regard to their care will also apply to pulley coverings.

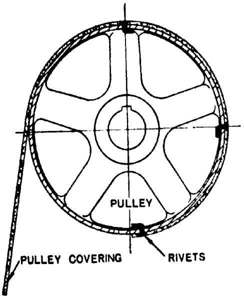


FIG. 310. — Pulley-covering riveted to pulley.

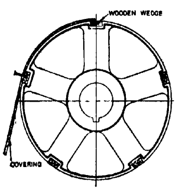


FIG. 311. — Pulley-covering nailed to wood wedges on face.

CHAPTER XXXII

CHAINS AND SPROCKET WHEELS

Types and Kinds.—Various types and kinds of chains are made, but the most common for use on farm machinery is termed detachable link belting, or sprocket chain. These may be made either of malleable iron or pressed steel. Their size varies from the smallest, such as are used on a grain grader, to the largest, such as may be used on the drive sprocket of a manure spreader. The sizes cover a range equivalent to leather belting from sizes of one inch to four or six inches. Malleable and steel detachable sprocket chains are not interchangeable on sprocket wheels. These sprockets should be expressly made for one or the other type.

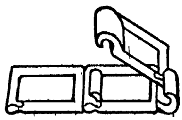


FIG. 312.—Detachable, malleable sprocket chain.

Operation.—There are a good many factors that enter into the successful working of detachable chains on farm machinery. When working under light load, and at medium speeds, these chains give very satisfactory service. On the other hand, if the loads are great, and the speed high, they are the source of much trouble to the farmer. The average agricultural engineer, however, has designed this farm machinery and provided these sprocket chains where they will give successful and satisfactory service.

In machinery requiring higher speeds, and a positive drive, it is common to find a higher grade steel chain used. Chains of this sort are frequently termed "pintle chains," and are

commonly found on lifting devices of tractor plows. For lighter loads the ordinary malleable chain is very common on binders, threshing machinery, and shellers as mentioned above. Roller chains, too, are frequently used on farm machines where high speeds are necessary and where fairly heavy loads are carried, such as on silage cutters, threshers, etc.

One of the first precautions to be taken in attaching the common sprocket chain is to see that this chain is put on the sprocket wheels correctly. The illustration, Fig. 316, shows the correct way to put a chain of the detachable link belt type on sprockets. It is quite important to see that this method is always followed. One of the greatest troubles with chains of this sort arises from their frequent tendency to climb the sprocket. By this is meant that the chain has a tendency to work to the top of the tooth on the sprocket wheel, and in so doing tighten it, frequently to such an extent that the chain will be broken. This may be due to two or three different things. One of the most common is that the wrong chain is used in combination with the sprocket. In other words, it is important that the sprocket and chain fit each other. Chains are all made and numbered to correspond to the pitch or distance from the center of one link to the center of the next. It follows that the sprocket and chain must correspond in pitch if they are expected to work together.

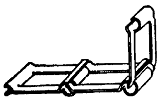


Fig. 313.—Detachable, steel sprocket chain.

A sprocket wheel, even of the right size, will, when badly worn, cause the chain to creep toward the top of the tooth, bind, and, ultimately, break. A chain that is run too fast may have the same tendency, and a distance between the driver and the driven sprocket which is too great is particularly aggravating. The slack is taken up on one or the other sprocket wheels and brings about a tendency of the chain to climb the tooth of the sprocket. Another reason for this tendency is that the chain may be run on the sprocket bottom-

side up. This also should be watched, because in field work it frequently happens that when a chain is put on hurriedly or by a person unfamiliar with this work, it gets wrong side up. In the first case, the remedy is a sprocket and chain that are made for each other. In the second case, the remedy is a new sprocket wheel, because a badly worn wheel could not very well be expected to give good service. In the third case, where the chain was too slack, the remedy is a chain tightener, or idler, on the slack side of the chain. In the fourth case, of course, if the chain were on wrong side out, it should be reversed.

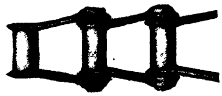


FIG. 314.—Pintle chain.

Besides these things which cause the chain to climb, and become tight and break, there is another which happens although rarely, since sprocket wheels are made by more modern molding equipment in the foundry. Heretofore, sprockets were sometimes made slightly large in diameter, due to swelling in the mold or undue wrapping in the foundry, which would cause the chain to climb. In most cases it was possible, by the aid of a half round file, to file away a triffe between the teeth of the sprocket all the way round—always a sure relief from further difficulty of this sort. While it is possible to run sprocket wheels a little out of line and still get fairly successful results from the chain drive, it is not desirable to do so, because it is bound to cause unnecessary wear on both the chain and the sprocket wheels. The sprocket wheels should always be exactly lined up with each other.

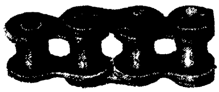


FIG. 315.—Roller chain.

Some manufacturers follow a plan of making a slight difference in the driving and driven sprockets, although both sprokets may have the same number of teeth. This is done according to a rule which is customarily followed in the engineering departments and which brings about better results and operation. Care should be taken that if the wheels are marked

"driver" and "driven" they work that way. The driver, of course, is always considered the sprocket which furnishes the power to the driven; this point should be noted by the man working about the machine.

Where an idler or tightener of some kind is used on the detachable link chain, it is well not to set it so tightly that it will cause excessive wear on the chain or on the bearings of the shafts on which the sprockets are located. This idler or tightener should always set square with the chain, and run perfectly free. It should be used on the slack side of the chain.

Pintle Chains on such machines as spreaders, plows, shellers, etc., require the same care that has just been described, and what was said about the wear on sprockets or chains with

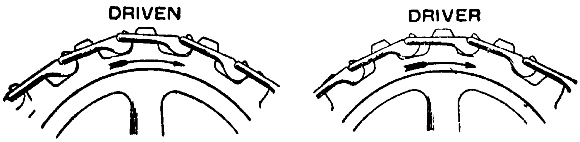


FIG. 316.—Detachable sprocket chain should be run as shown. Hooks up and running first.

reference to the use of tighteners, etc., also applies. The pintle chain is malleable iron, but the pitch is considerably greater, and the loads they carry are also greater. Often they are provided with oil holes on each link, and these holes should be on the outside.

Roller chains are also commonly used on machines such as silage cutters, threshers, shellers, etc., but they are of a higher quality than either of those types mentioned above. This chain is made of steel, and in many cases the roller on each link is hardened. Another feature is the fact that they should be used on cut sprockets made to fit accurately. Unlike the other two chains, roller chains may be run at reasonably high speeds and with heavy loads. Since roller chains are of a higher grade, it follows that they must get better care. Not alone is it necessary that the sprocket wheels on which they

run should be of steel and in perfect alignment, but where the centers of the shafts are more than 12 or 14 inches apart, tighteners or idlers should always be used. These chains are not so easily detached as are the other two types, and because of this they are stronger, and less breakage occurs. Rapid detachment is unnecessary.

Lubrication of detachable chains of the type mentioned in the first part of this paragraph is unnecessary, but when they are used in a dry place they may be oiled frequently. When pintle chains are provided with oil holes and the load is excessive, the chains should be oiled every half day, unless they work in very dusty and dirty places. High grade roller chains, however, since they carry heavier loads and run at higher speeds, should be oiled frequently. In many cases, roller chains are run in a dust and oil tight case and consequently they are amply lubricated and kept free from dust and dirt. It is to be remembered that these chains are composed of a good many small parts and, working as they do on each other, require frequent oiling. It is a good plan, therefore, to see that these chains are running in oil. Where they are run open, and without an enclosure of any sort, they should be oiled very often. It is well to remove them at the end of a day's run, if they have been working hard, and clean them with kerosene. In some cases, this can be done with the chain in place, by saturating a cloth with kerosene and thoroughly wiping the chain to remove all excess dust and dirt. Afterward, the chain should either be dipped in a light oil or if left on the machine, wiped with another cloth saturated with a light lubricating oil to be sure that every part of the chain is thoroughly oiled. When the machine is to be used, this oiling process should always be done just before starting up, whereas the cleaning process should be done just

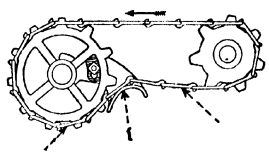


Fig. 317.—Tightener on slack side of chain.

after shutting down. This will insure maximum performance with a minimum amount of wear, which means better results throughout.

It should be remembered that power is being transmitted from one shaft to another and that these chains afford a positive means of doing this. Belts of the ordinary type always allow or at least permit of a little slippage, whereas no such thing can occur when metal chains of any sort are used. They, therefore, call for positive performance and the things mentioned above should be carefully guarded against. The results obtained from such driving devices will be in direct proportion to the care that is given them. Since all of this machinery is used at a critical time on the farm, it follows that although they are only chains, they should get just as much care and consideration as any other part of the machine.

CHAPTER XXXIII

LUBRICANTS AND LUBRICATION

Any medium which reduces rubbing friction between two moving bodies may be considered a lubricant. Generally speaking, lubricating oils are of three different mediums: animal oil, vegetable oil, and mineral oil. A combination, or a "blending" as it is termed, of some of these is also satisfactory and practical.

Kinds of Oils.—*Animal oils* used for lubrication are lard, tallow, sperm, seal oil, etc.

Vegetable oils used for lubrication are castor oil, olive oil, cotton seed oil, etc.

Mineral oils used for lubrication are those made from crude petroleum, and they may cover a great range from white oils, like kerosene, to the heavy black oils. This range includes the different processes in distillation of the crude oils.

Animal oils have the disadvantage that they become rancid, due to the action of heat, and the process of heating-up produces an acid which very often is harmful, in that it attacks the metal which it is supposed to lubricate.

The general requirements of lubricating oil and its value as a lubricant depend upon what it is to be used for. It would be inconsistent to use the same oil for lubricating a high speed spindle which might be used for lubricating the skein and hub of a threshing machine truck wheel. There are several factors which must be taken into consideration. These are pressure, speed, and temperature. They may be further divided into light, medium or heavy pressure; slow, medium or fast speed; and low, medium, or high temperatures. In general, it may be said that light pressure will range from 50 to 150 pounds

per square inch bearing surface, medium 150 to 450 pounds, and heavy up to 1300 or 1400. Speed given in revolutions per minute may cover a range as follows: Slow speed from 60 to 250, medium speed from 250 to 800, fast speed from 800 to 2000 or 3000. Temperatures may range from 60° to 120° F. as low, 120° to 240° F. as medium, 240° to 480° F. as high.

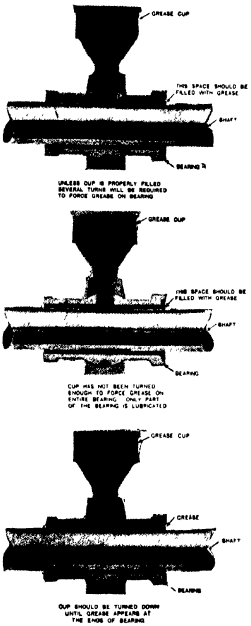


FIG. 318.—Proper manner of greasing a bearing by means of a grease cup. (Note black indicating grease in lower illustration full length of bearing box.)

Method of Lubricating.—Where fluid oils are used, the size of the oil holes should be in proportion to the thickness of the oil used. The number of them is usually in proportion to the length of the bearing. The amount of oil needed is in proportion to the load carried and the size of the bearing used. In some cases the bearings must be actually flooded with oil so that the shaft in the bearing itself will never be in danger of touching, which would cause trouble. The theory upon which all lubrication is based is that the two surfaces should be separated from each other by the lubricant. The small particles of oil must actually separate the two surfaces and prevent them from touching each other. If these surfaces do touch, heat is instantly generated, and as the rubbing increases so does the generation of heat increase, which means a "hot-box" and a ruined bearing, and often a ruined shaft also.

Greases.—Greases of various kinds are usually forced

rough a conventional type of grease-cup, from which they e conveyed to the place to be lubricated. The various elements mentioned above may be used in the form of a grease solid lubricant. Animal fats, vegetable waxes, and solid ls, mixed with lime and other solid substance such as peoleum jelly and vaseline, are used in compounding and mixg greases or hard-oils. Even soap is sometimes used as a edium for mixing them. A combination of different lubrints can be mixed together to make solid-lubricants or greases, id there is hardly any limit that cannot be covered in getting fferent degrees of lubricating qualities from such combinaons. Generally, however, the highest grade greases contain imal fats and mineral oil jelly. Even soapstone, mica, and metimes graphite are mixed with these to impart various grees of lubricating qualities, but such greases are of an ferior kind.

Greases may be divided into three classes: "Compound," Set" and "Boiled." Compounded greases are composed animal fats, paraffin, waxes, and cheap oils. They become ncid and in that state are unfit for lubrication. Set greases e also termed axle greases. They are mixtures of low grade s, resin oil, and fats. Often, too, they contain soapstone, aphite, mica, or suphur. They are good only for axles of rm machinery and other heavy machinery. Boiled grease commonly termed "cup grease," and may be divided into ur grades: 1, 2, 3 and 4. Number 1 is the softest and 4 the rdest. Cup greases may be safely used on almost any rm machinery provided with compression grease cups. Of urse, the grease selected should be determined by the reiirements of the machine in question.

Oil for Anti-Friction Bearings.—These bearings are very gh grade and made of a good quality steel. What has just en said with reference to the selection of oils for machines different kinds, with reference to pressure, speed and temratures, will apply also to oil for anti-friction bearings. It not a good plan to use a heavy black oil on an anti-friction

bearing that operates at a high speed such as might be used on a thresher; it may even be a detriment to do so. The churning effect of an oil in this case will generate in itself heat enough to cause trouble. It should be the aim to use an oil consistent with the conditions under which the bearings are working. One of the essentials in the selection of an oil for anti-friction bearings of any kind, however, is that the lubricant be free from alkali, acids, and moisture. It must also be free from foreign substances such as cork, saw-dust, or even graphite in any form. In general, a "medium" motor oil will be found satisfactory for use in anti-friction bearings. It will be difficult for the power farmer, or the user of machines, to know exactly whether these elements are present in the lubricant he buys, yet any reputable dealer in oil will be glad to furnish a lubricant of these specifications for oiling anti-friction bearings. He will tell you frankly whether his lubricant contains them. It must be expected, of course, that the price has some relation to the quality of oils, just as it has in any other commodity.

The following classification will cover lubricating oil in a general way:

1—*Cylinder Oils:*
- a—High pressure for steam from 140 to 200 pounds.
- b—Low pressure for steam from 14 to 140 pounds.

2—*Crank Case Oils:*
- a—Heavy, for heavy loads, medium speeds and high temperatures.
- b—Medium, for medium loads, medium speeds and high temperatures.
- c—Light, for light loads, high speeds and high temperatures.

3—*Dynamo Oils:*
- a—Heavy, for heavy loads, high speeds and low temperature.
- b—Light, for medium loads, extremely high speeds and low temperature.

4—*Engine and Machine Oils:*
- a—Heavy, for heavy loads, slow speeds and medium temperature.
- b—Light, for medium loads, high speeds and medium temperature.

In addition to these there are also a number of special oils for air compressors, cutting oils, cooling oils, etc. Many are combinations of those listed above.

For general farm machine lubrication, the oils in class "4," listed as "Engine and Machine Oils," will in the (a) and (b) classes serve for all general purposes. Engine and machine oils are practically the same. These oils may be yellow, amber or red mineral oils and may even be compounded with animal or vegetable oils. Engine oils are usually better refined and blended and are therefore slightly higher priced. Oils purchased under the name of "Castor Machine Oils" are usually thickened with other substances and are not so desirable as the high grade machine oils. They should never be used on any farm machinery.

One essential in selecting an oil for farm machinery is that it comes within the class given in the table, and that it be purchased on the basis of doing the work for which it is intended. To get satisfactory results from cheap oils is impossible. In fact, the value of an oil as a lubricant should, in a measure, be proportional to the price paid. It is inconsistent to expect to get as good results from oil costing 20c a gallon as from an oil costing twice or even three times as much. In reality a gallon of good oil will go much further, and do more effective work, operate the machine with less danger of trouble and with less power, than a cheap oil. The best oil within reason, then, consistent with the machine on which it is used, will prove the cheapest in the long run. The same thing is true of greases of various kinds.

Care of Lubricant.—In the first place, it is well to buy these oils in quantities; either a barrel or half barrel,—for two reasons. one is that they may be purchased for less money, and the second that in these containers they are more apt to be kept clean and free from dust and dirt.

The various funnels and measuring containers through which the oils is poured—or even the oil cans, if the oil is to be run from the barrel to an oil can—should always be kept clean. A barrel of oil should never be allowed to stand outside, but should be under cover, preferably in the work shop or some place where there is a minimum of dust and dirt blowing

about. Since one of the greatest enemies to all farm machinery is dust and dirt, to get it into a machine and into the oil in the very bearings of the machine is the worst practice that can be carried out.

A dust-tight cupboard built of boxes, with a door in it, fastened to the wall near where the barrel of oil is kept, is a very handy thing to have, and it affords a fine storage place for these measuring devices and the funnels.

Greases, too, should be purchased in cans of 25 to 50 lbs. each and the cover always kept on them while not in use. It is a good plan to fill a small can that has a good cover to take into the field or to wherever the machines are that are to be lubricated. This can may be filled from the large one in the shop; then the large supply will not be so apt to become contaminated with foreign substances, such as grit and dirt.

CHAPTER XXXIV

TOOLS AND SHOP EQUIPMENT

Every power farmer should have a shop. This does not necessarily mean a factory, but merely a place that may be termed a shop, in which such tools may be kept as are needed for making repairs required to keep the machinery in the best working condition.

It may well be incorporated in a building that houses the tractor and other implements. This shop should be a place that may be heated with a stove. It should have a substantial floor. It should be big enough to house the tractor also. This is desirable, because during the slack period in winter it affords an opportunity to overhaul the tractor in a heated room or building, and in addition it also provides an excellent place in which to work on the motor car or truck—frequently found necessary.

The shop should contain the following list of tools,* which will be found practical for all general farm repair work:

TOOLS FOR WOOD WORKING

Ax 4½-pound size	Hand ax
Hatchet	Hand saw—crosscut
Compass saw	" " —ripping
Steel square	Draw knife
Bevel "	Brace
Auger bits—set of eight	Screw driver—2 sizes
Gimlet " " " "	" " —for brace
Auger T handles—4 sizes	Jack plane
Wood chisels straight—6 sizes	Smoothing plane
" " gouges —3 "	Claw hammer
Claw bar	Riveting hammer
Spoke shave	Wood rasp—3 sizes
Folding rule	Chalk line
Plumb bob	Spirit level

* From Bulletin No. 347, issued by the U. S. Department of Agriculture.

Tools for Iron Working

Machinists' hammer
Riveting hammer
Punches
Coal chisels—4 kinds
Files—6 kinds
Blacksmiths' hammer
Vise
Hack saw frame and blades
Soldering iron
Thread cutting appliances
Pipe fitting appliances
Monkey wrench—3 sizes
"S" wrenches—6 "
Alligator wrench
Pipe wrench—2 sizes
Forge
Tongs—3 kinds
Drill press and drills
Ratchet drill
Chain drill

Miscellaneous

Trimmer snips
Pliers—3 sizes
Crow-bar
Grindstone
Oil can—3 kinds
Staple puller
Rivet set
Dividers
Cutting snippers
Maul—20 pound
Oilstone
Wire stretcher
Leather punch
Awls

Special Conveniences

Work bench with wood vise and iron vise
Saw horses—one pair
Mitre box

The anvil can best be mounted on a block of end wood set well into the ground before laying the cement floor, or even a good clay dirt floor is satisfactory for this part of the farm shop. The forge must be set so that the smoke will find an easy outlet into the chimney. It is a good plan to purchase high grade tools. Rather, a few, well selected and of good quality will, in the long run, prove more valuable to the power farmer than many cheap and inferior tools. Racks or empty cigar boxes set on a shelf will make good receptacles for all small sizes and kinds of bolts, nuts, wood screws, nails, etc. A cupboard on the wall to hold the tools is also a big convenience. Most shops that are on the farm too often become a store room, like an attic in a house, for almost anything that the farmer wishes to dispose of in a hurry. It should be a fixed rule that nothing but the tools and such pieces as need repairing are stored in the shop.

The shop should be provided with racks on which several barrels of lubricating oil may be placed. This oil may be drawn and used as needed. The oil is more apt to be kept clean, and so, too, are the funnels and pouring cans. It will be found that this part of the power farmer's equipment, his repair shop, will be as valuable to him as any implement he may have. It will become as valuable as the tractor itself, for the success of the tractor and the machinery that goes with it is largely proportionate to the care they receive and this care is proportionate to the facilities that the farmer has for giving it. A farm shop and a good tool equipment are, therefore, most essential.

CHAPTER XXXV

HOUSING MACHINERY AND WINTER STORAGE

Agricultural machinery is designed and built to do a certain amount of work in a certain way. It represents a big investment to the farmer, which, on an average, in the principal grain growing states, in farm machinery to-day, is close to $1,500 per farm. Therefore, to get the best out of these machines proper care must be given them. This, in turn, means proper housing when they are not in use. The housing of machinery is important and is gaining recognition by farmers everywhere. One of the greatest factors which tend to reduce the efficiency of machinery is the fact that through neglect during that period when they are not being used they deteriorate rapidly. Depreciation is one of the biggest factors of expense in farm machinery with which the farmer has to contend, and it is largely due to the fact that so many machines are not properly housed when they are not in use. Investigations have shown that farm machinery depreciates at the rate of about 10 percent per year on an average. On some machinery this figure is twice as much.

A machinery building and shop combined are a means to this end. It may also be the one to house the truck or automobile. Motorized farms are today a reality. Their importance is becoming recognized more and more every day. To prepare for this era of development is logical. It is entirely practical to put up a building that will afford housing for all farm-operating machinery including its power units. This building may be made of wood and its construction as a whole made to suit the farm in question. The locality, and the type and kind of adjoining building should have an influ-

ence on the material used for this building. Since modern farming machinery includes a tractor, and since an automobile is in nearly every case a part of the farmer's equipment, it is suggested that this building be made to house both machines. Since this building houses machinery which is set entirely on the ground, the structure need not be a very expensive one. Its roof must support only snow loads and resist wind pressure. It is desirable that it be divided into several parts.

The following table shows how many days a year some common farm machinery is used and for how many years it lasts. These figures are taken from Bulletin No. 338, contributed from the office of Farm Management of the U. S. Department of Agriculture and represent averages:

IMPLEMENT	LIFE OF IMPLEMENT		ACRES COVERED	
	Days of Work	*Years*	*Per Year*	*Total*
Sulky Plow	119	8.1	30.9	250.3
Spring Tooth Harrow	73	11.0	71.1	782.1
Spike " "	43	14.0	48.3	676.2
Disc Harrow	54	13.0	35.2	457.6
Grain Drill	76	16.4	46.3	759.3
Mower	46	14.8	28.0	414.4
Hay Rake	37	14.5	43.0	623.5
Grain Binder	53	15.4	35.2	542.1
Corn "	40	10.8	21.1	227.9

Added to this is the fact that farm machinery is being made better every year. The advent of the tractor has brought about designs that make for machinery to work with it, and it must, therefore, be better machinery. The trend of design of agricultural machinery is toward something better, and for this reason housing and proper care of machinery is more essential than ever.

The fact that many repairs can be made on farm machines by the farmer himself calls for a shop where these repairs

may be made, and this can also be a part of this building. It is desirable that it be provided with a chimney so that the part which contains the shop may be heated so that work can be done on the tractor, the truck, the motor car, the plow, the harrow, the thresher or any other farm machine during the cold days of the winter or at any time when farm work is slack. The shop may be made large enough so that it will be convenient to work around all sides of a tractor when it

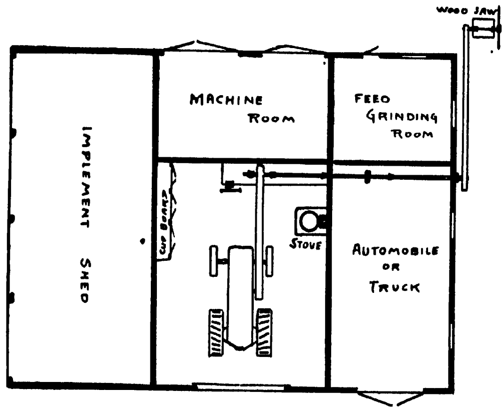


FIG. 319.—Plan of shop and implement shed.

is being repaired or overhauled. It is also a good plan to provide a beam overhead in the shop itself, so that a hoist or a block and tackle may be fastened to it when it is necessary to take out the engine transmission or any heavy part of the motor. This beam will also afford a convenient means of unloading any heavy article from a truck or a wagon—such as a barrel of oil or anything that is heavier than would be convenient for one man to handle otherwise.

It will also be found convenient to have a wood floor in the entire building. If, however, this is not desirable, the part

of the building housing the implements themselves should at least have a floor of cinders, gravel or crushed stone.

The illustration shows a plan that will incorporate the features mentioned above. The doors on the implement side of the building itself may be sliding doors, and those of the shop and garage hinged. The plan suggested in the illustration has, as may be seen, a "lean to" on each side. This building, therefore, may be put up in parts. The center may be put up first and one or both additions put on later. It is well to consider this point when contemplating such a building, since it is economical and lends itself well to the purpose.

The location of an implement house is important. First, it should be located near enough to the farmstead itself that

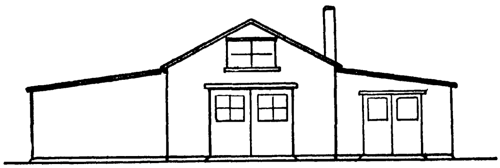


Fig. 320.—Elevation of shop and implement shed.

it can be conveniently reached. It should be located conveniently to get machinery in and out when needed, without crowding. If convenient, it should be set so that it is possible to drive anywhere around the building and enter it with a tractor or remove any machinery from it. It should be set in a place on high ground, to make sure that it is well drained.

When putting machinery away, it is well to go over it very carefully and itemize those parts that need repairing or special attention. Plows, harrows, cultivator shovels, and parts that have polished surfaces should always be "doped up" with grease to prevent their rusting. The tongues or pole of these various machines, even though short, should be removed. Removal of these parts not only permits of closer storage, but it also enables the farmer to set them in a vertical position

so that they will keep their shape better and not tend to warp.

Belt-power machinery stored in a shed of this sort should receive similar treatment. It is a good plan to "dope up" and grease the shafting on which pulleys are located, to prevent these parts from rusting and to enable the farmer to remove the pulleys when he finds it necessary.

The sickles should also always be removed from binders and mowers, thoroughly greased, and hung in the shop part of this building. The canvas from the binder always should be removed. It is best to hang this on the wall strung out at full length so there will be no danger of its getting mildewed from moisture or spoiled in other ways. It is not a good scheme to roll up a canvas because this affords a nesting place for mice and squirrels, which is very apt to spoil the canvas.

A doorway at least ten or twelve feet wide should be provided for the implements, and fourteen feet is much better. This will enable the farmer to get a large drill into the door, or a wide machine of any sort.

The space required for housing the implements used on the average 160-acre farm only should be from eighteen to twenty-four feet wide and about forty feet in length. Where the need for a larger building becomes apparent, it is desirable to build it larger, because it is very important that if a machine is to be housed at all, it should all be under cover and none of it neglected at any time.

Machinery built of wood or steel—such as threshers, shellers, silo fillers, etc.—should always be well cleaned before they are put away for storage. A thresher, for instance, should always be run for some time after threshing is finished in order to clean it thoroughly on the inside. At the same time the outfit should be free from the accumulation of the dust, chaff, and oil which are usually found around the bearing. It is well to be sure that the machine is put away in the best possible shape.

If the machines need painting, the painting should be at-

tended to at a time when work is slack on the farm. What has been said about painting refers particularly to machines constructed of wood. Season checks and cracks which afford a convenient place for moisture to enter should be filled with putty or paint; if not, rotting rapidly occurs at these places. Any first-class paint may be procured which will do very well for painting machinery of this sort. Steel machines or machine parts will not rust if the surface is well coated with good paint. A paint with a lead base is very good for metal surfaces that are exposed to the weather.

Belts, whether rubber or leather, should always be well cleaned and carefully hung up over a series of pegs so as not to make any sharp bends in the belting. Rubber belting of any sort should be stored in a dry dark place. In no case should leather belts be placed where they will be exposed to dampness and moisture. Canvas drive belts may be well cleaned and rolled up carefully and put away; they should be laid on edge rather than on their face. All belts should always be laid on edge when rolled up for storage.

CHAPTER XXXVI

ORDERING REPAIR PARTS

Since accidents are bound to happen, repairs must be made. Machinery of any kind used at all is bound to need repairing from time to time. Accidents and careless operators will cause breakages, and these must be repaired. Farm machinery is no exception. For farm machinery to work well requires that it must be in good repair and in first-class running condition. Realizing the importance of this, all farm machinery manufacturers have provided departments which cater to the farmer in emergencies. These departments are usually referred to as "Repair Departments" or the "Extra Departments" or "Service Department."

The branch houses of the various manufacturers carry large supplies of repair parts that may be procured on short notice. Even the dealers in many small towns carry a liberal supply of those parts which are most likely to cause trouble during the season. Since it is a big item of expense for the manufacturer to carry such enormous quantities of repair parts in his various branch houses and at the dealers, it is necessary to sell these parts at a rather high figure to cover the expense of large inventories. However, a realization of the importance of doing farm work at a critical time is the reason for carrying these parts in such quantities. It is, after all, worth a good deal to the farmer to know that when a machine part does break he can, in a very short time, get a new piece which will enable him to repair this machine and go on with his work without seriously handicapping him in his plan of production. To carry a supply of extra repair parts of every single kind with every dealer and always have an adequate

supply on hand is utterly impossible. The manufacturer, too, frequently has accidents and trouble at his plant which hinder him from getting his work out; and often the branch house or the dealer is not supplied with a piece that may be wanted because of such troubles. This is rare, however, and when it does happen, allowance must be made for it, as it is bound to happen once in a while in any institution.

Manufacturers of agricultural equipment publish printed lists of all parts that go to make up a machine of any kind. Every piece that enters into a machine carries what is termed a "Shop Number." On those pieces, which are made of cast iron, malleable or brass, it is customary to cast the numbers so they are plainly visible from the outside of the piece itself. Very often manufacturers carry besides the number a symbol letter which may be used in combination with the number, either as a prefix or a suffix and very often both. This combination of a number and letter constitutes the means for identifying this particular piece. The printed circulars, or repair lists as they are commonly called, give these numbers, together with the names and the location in the machine on which they are used. They also list, in most cases, the price which a particular piece will cost. If it should happen to be a piece of shafting, a wrought iron bracket, or some sort of wooden piece, its size or name is generally given, together with a number and the price. Parts are usually listed in groups, relating to important parts of the machine; for example, all parts of the platform of the binder would be listed together, and all parts of the sickle bar of a mower would be found listed together. Throughout the entire line of farm machinery, this is the case.

When it is necessary to order a repair part, it is very important first of all to see if the part is a casting, what its number is and to be sure that this number is ordered correctly. It is also important that the name of the particular casting be procured from the printed repair list, and given correctly in the order, together with the size and name of the

machine of which it is a part. If the machine has a serial number, as many large machines such as threshers, shellers, silo fillers, etc., have, the serial number should also accompany the piece number. If the implement is a plow or harrow, its size and style or type number should be given.

Repair parts should always be ordered early in the season and, as mentioned before, it is a good plan to list the parts that need repairing before the machinery is put in storage for the winter. Still a better way is to get these repair parts and put them on the machine before putting the machine into storage. By this plan not alone will the farmer be assured that the parts fit and work well, but he will be relieved of the anxiety of getting them for the machine when the time comes.

How to order repairs has been explained. The following information in ordering parts for any machine should be remembered:

(a) The name of the machine and the model.
(b) The size of the machine.
(c) The serial number of the machine (if it has such).
(d) The number of the part, together with its name.
(e) The number of parts required.
(f) The shipping directions which will include complete address, giving the postoffice, town or city, together with the county and state.

It is also important to state whether the shipment is to be by freight, express, or parcel post.

The same plan applies to ordering the repair part by mail. It is well to remember, however, that all this information, excepting (f) should be taken to the local dealer or to the branch house to get a particular part. It is also very important to remember that in practically every instance repairs or extras for farm equipment of any sort are sold on a cash basis only. When these parts are ordered by mail, a check or postoffice money order, or a bank draft should always accompany the letter. If this is not done, perhaps they can be ordered C.O.D. It is an iron-clad rule with most manufac-

turers not to ship anything without the money and it is well to remember this when purchasing repair parts, particularly when ordering them direct from the factory or the factory branch house, or from the authorized distributer or jobber.

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